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ARCHIVES OF NEUROLOGY AND PSYCHIATRY

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THE SPECIAL FIELD OF NEUROLOGICAL SURGERY AFTER ANOTHER INTERVAL*

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Those engaged in scientific or professional pursuits have need of a periodical accounting of stock no less than those engaged in business. The results of such an inventory may sometimes be of more than personal interest, especially when projects have been undertaken which are in a measure novel or special, for their success or failure may encourage others or may deter them from similar adventures.

SPECIALIZATION IN GENERAL

In a sense, I suppose, every medical graduate tends in time to particularize to a certain extent, and through liking or opportunity comes to be known as more expert or better informed than his fellows in one thing or another. He may have had an unusual experience in relation to child-birth, shown unusual skill in dealing with the ailments of children or with the maladies to which their mothers are heir. He may have a mechanical bent and be particularly apt as a setter of broken bones or a corrector of deformities. He may be a particularly good microscopist or show greater facility than his contemporaries in the use of some other precise instrument of importance in diagnosis. He may have become engrossed in some special disease, indeed of some particular organ, or what is more, of some special form of treatment for a particular disease of a particular organ. His interests may become purely scientific or purely sociological and take him away from the bedside entirely. Of all this there is no end or ever will be. For there are ways innumerable in science or practice in which we as individuals or groups of individuals come to particularize in our work.

The participant in this subtle process of specialization may not always be conscious of it, or, if he is conscious of it, may not wish to admit the fact even to himself, and would encourage his employers,

* This address was made to do double duty before the Tri-State District Medical Society at Waterloo, Iowa, Oct. 7, 1920, and the Cleveland Academy of Medicine, Oct. 8, 1920.

be they trustees, patients or the commonwealth, to believe that he is equally capable of dealing with all branches of his larger subject. On the other hand, the concentration of effort may be intentional and represent a desire to contribute to knowledge, rather than income, though they are not necessarily divorced, and for this the individual must perfect himself in certain directions rather than others.

Thus the specialist and specialties arise, but in the case of each of them, should progress cease after a generation or two, it is inevitable that the imitators of the pioneers will diminish in number as well as quality. And when this time comes, following a period of more or less disrepute, the particular species of specialist dies out, and the prodigal specialty returns to, or should return to, its parents. If this happens, the reunited household will unquestionably have profited by the episode.

Medicine has grown in the fashion of a banian tree. In the beginning there was a single stem. This, in the remote past, each professional aspirant learned to climb, and in his lifetime could encompass without difficulty all the knowledge its various branches represented. But from the main branches which the original tree put out, particularly from physic and surgery representing the application of medical knowledge to practice, there soon dangled many roots. Some of these finally reaching the ground became attached, and drawing up their own nourishment have in some cases enlarged and become permanent and necessary supports to the parent branches.

Modern aspirants sometimes climb these outlying props, mistaking them for the main stem or believing that they have found a short and less crowded way to the top where others they wish to emulate are seen to perch. The temptation is great and to some irresistible, but short cuts to specialization without thorough preparation in the fundamentals make incompetent if not dangerous practitioners, and so long as this is permitted within the profession itself we should be less intolerant of those who have smuggled themselves into the tree with no medical preparation whatsoever—the osteopath perched insecurely on a limb propped by massage and the Christian scientist tip-toe on another feebly supported by psychotherapy.

Be this as it may, in time there has come to be a veritable grove of trunks, and every season new roots become grounded in such increasing numbers that it is difficult for the untutored to realize that the growth really represents a single tree. To be sure, an outlying prop to a limb may occasionally dwindle and disappear as botany has disappeared: or, after a period of temporary vigor, it may become incorporated with an adjacent and more vigorous one, but the general ten-

dency is for a further and rapid multiplication rather than for any reduction in number, for, though no longer needed, an old prop dies reluctantly if once it has come to support an important branch.

Near the center of the tree are two particularly large parent branches, one of them perhaps more flourishing and well supported of late than the other, but both of them apparently essential to the welfare of the tree. From legend alone do we learn which of the two probably represents the main stem and which the secondary offshoot. Whether physic was a specialty which branched off from general Medicine before surgery, or surgery before physic, is not quite clear.

In its westerly transplantation to different countries in successive eras the tree of Medicine, to be sure, has not always put out the same branches in the same way. We may recall the words of the distinguished Philadelphian, John Morgan, who in 1765, on his return from Edinburgh, announced in his justly celebrated "Discourse" his intention of limiting himself henceforth to "those cases which belong most immediately to the office of a Physician" and of no longer "interfering in the proper business of Surgery." From this it could be argued that the practice of physic thus withdrawn from general Medicine, which included handicraft, became in this country at least the first avowed specialty. For the real standard of specialization is the determination to avoid diffuseness by withdrawing from participation in the wider field and by devoting oneself to a more limited one.

One might pursue this subject further and trace the development of some of the various secondary offshoots both of physic and surgery in the past and see what has happened to them—whether they have taken secure root and continued to flourish or whether after a generation or two they have either died back or become incorporated again with one of the main stems by fusion—but interesting as this might be, it is not the purpose of this essay.

New specialties at present undreamt of will continue to arise. It takes little to start one. The diseases incidental to a novel occupation like aviation; the introduction into the clinic of a new discovery like Wassermann's reaction, or Roentgen's ray; a new instrument of precision like the calorimeter—such things as these will make a succession for all time of unlooked for opportunities for us and our followers in Medicine to engage in new endeavors under novel conditions.

These must be regarded as accidental occasions for specialization, to be distinguished perhaps from the purposeful determination to specialize within an established branch long occupied. But under both circumstances those who can best take advantage of existing opportunities, or can originate others, not only must have had a good general

training in clinical medicine and surgery, but must have been thoroughly schooled in the fundamental subjects—in the anatomy, physiology and chemistry of morbid as well as of normal tissues and organs—for without this knowledge any special branch is supported by a root lodged in sand which does not long survive overloading. There is only one way to get a secure seat on any outlying branch and that is by approaching it from the main stem, no matter how wearisome, laborious and time-consuming this process may be.

SPECIALIZATION IN PARTICULAR

In 1905 [1] and again in 1910 [2] a paper was read before the Cleveland Academy of Medicine on this selfsame subject of Neurological Surgery as a specialty. The first of them was written shortly after the decision was made to limit my operative surgical work to what seemed to my several advisers, and indeed to me at the time, to offer small pickings. There had dangled for a long time from the branch of surgery, if we may continue with our banian-tree simile, a wisp of root over a very unpromising patch of soil. It had become attached on more than one occasion, though feebly to be sure, and had been tested thoroughly by Agnew in this country and later by von Bergmann in Germany; it had for reasons not far to seek been abandoned as both unfruitful and unsafe. Later on, Victor Horsley turned his brilliant mind to the subject with far greater success than his predecessors, though he showed more interest and perhaps skill in its physiologic than in its purely surgical aspects.[3] Specialization is an uncompromising mistress. It was an avocation of Horsley's, not a subject to which he limited himself, and though he had imitators he left no disciples.

It hardly seemed possible fifteen years ago that the surgery of the nervous system by itself could furnish material enough to occupy a surgeon's undivided attention and insure him a livelihood, far less that it would promise opportunities within itself for further specialization on subjects like tumors of the brain in general or tumors of the pituitary body in particular. Time has shown, indeed, that these early misgivings were unfounded, and that there is not only an appeal but abundant opportunity for special workers who plan to restrict them-

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1. The Special Field of Neurological Surgery, Cleveland M. J. **4**:1 (Jan.) 1905; Johns Hopkins Hosp. Bull. **16**:77 (March) 1905.

2. The Special Field of Neurological Surgery: Five Years Later, Cleveland M. J. **9**:827 (Nov.) 1910; Johns Hopkins Hosp. Bull. **21**:325 (Nov.) 1910.

3. One of his colleagues, indeed, at the National Hospital went so far as to make a study of the brain tumor cases operated on there, and concluded that the average duration of life of patients thus afflicted was longer without than with an operation.

selves to this outlying branch is evidenced by the fact that a number of surgeons interested in the nervous system have organized themselves into an Interurban Neurosurgical Society in the expectation thereby of making more rapid progress in this specialty through an intimate interchange of opinions made possible by clinical meetings.

It is impossible within the limits of an address to enter at all fully into an account of all that has transpired in the field of neurologic surgery during the past decade, far less to give anything more than hints of what lies before us in the way of problems. I shall restrict myself, largely, to some of the topics which have engrossed the attention of my co-workers and myself during the interval, though they represent but a small portion of the larger work in which many have become engaged.

To conform more or less to the plan of my former papers I shall allude in turn to the surgery of the brain, the cord and the peripheral (cranial and spinal) nerves,[4] with such comment and digression as I may be led into under these separate headings. But before entering on these subjects I desire to say something about a mysterious personal quality necessarily possessed in varying degrees of perfection by every one who does something with his hands—namely, his technic.

NEUROSURGICAL TECHNIC

Perfection in the conduct of his therapeutic measures is as essential for a surgeon as is the technic of laying on colors for an artist or of producing sound for a musician. One may have abundant knowledge of art or music or medicine and yet be a poor performer. In surgery a proper technic is by no means the only element of success, but it is an important one.

Let us look back for a moment on the conditions at the beginning of the century, when from our present standards the methods of conducting both cranial and spinal operations were crude beyond the belief of our juniors who happily know better times. The day of the mallet and chisel for opening the skull was not far removed. An exploratory exposure of the brain was looked on by the prospective patient with

4. There is, too, a surgery of the sympathetic nervous system, poorly developed it is true and hardly recognizable even in this its experimental stage. We have had glimpses of it in certain operations for goiter, in certain forms of treatment suggested for Reynaud's disease; and the proposals by Lèriche, in regard to a purposeful surgical paralysis of the vasoconstrictor nerves which accompany the blood vessels, are straws to show the direction of the wind.

The influence of the vagus and the splanchnic nerves on the viscera; the relation of emotional states to metabolic stability; Cannon's experimental anastomoses between phrenic and cervical sympathetic, with their remarkable sequelae—these things indicate what may lie before us if imagination is turned to the application of some of the facts known to physiologists regarding the autonomic nervous system.

the same dread with which an abdominal operation had been regarded a generation before, and by the surgeon with comparable misgivings. Few, if any, operators ventured to undertake one of these procedures except under the direction of a neurologist, and only then when conditions had advanced to such a point that the diagnosis could be made beyond peradventure, though by this time, alas, in the presence of tumor, tension within the skull had become extreme. This made a procedure with inherent technical difficulties extremely hazardous, not alone at the moment of its performance but the ensuing complications due to imperfect and hasty closures led with disheartening frequency to complications which sometimes prolonged an existence worse than the original disease.

The most crying need, therefore, in the early years of the century was for an improvement of our technical methods under the realization that what had sufficed for other organs and tissues, when applied to the surgery of the nervous system, was disastrous. Therein lay the failure of Agnew and von Bergmann.

Fifteen years ago we were scarcely at the dawn of an understanding of purposeful decompression for brain tumors. To be sure, the observation had been made and reported more than once that after an occasional osteoplastic exploration which either revealed no growth, or one supposedly unremovable, an entirely unexpected amelioration of subjective symptoms had taken place. However, inasmuch as most of these early operations had been confined to the more accessible central region of the hemisphere, these subjective benefits were more than offset by postoperative paralyses from protrusion of the tense brain through the cranial defect. When the idea of a purposeful decompression over relatively "silent" portions of the brain, conducted, moreover, in areas like the temporal and suboccipital regions where an undue extent of protrusion is checked by securely closed extracranial muscles—when this idea finally took hold, the old explorations which had resulted in a certain measure of relief were resurrected and tabulated as decompressions in our modern sense, which they were not either in reality or intent.

With the development of a reasonably safe and satisfactory procedure for relieving tension both for cerebral and cerebellar lesions, and one which of itself did not lead to paralyses, these palliative operations began to multiply and it soon became apparent to all that the accepted views regarding the cause of what was called optic neuritis, resulting in atrophy and blindness in tumor cases, would have to be revised. For it was obvious that an inflammation of the nerve could not explain a process capable of being checked by the mere relief of pressure, so long as the tumor, to which the supposedly toxic neuritis had commonly been ascribed, remained unremoved.

Inflammations of the optic nerves due to toxic substances and capable of producing atrophy doubtless exist, but changes in the nerve head observable to the ophthalmoscope are infinitely more often due either to an increasse of cerebrospinal fluid tension or to direct pressure on the nerve by tumors in the region of the chiasm than to any other cause—so much more often that rhinologists and ophthalmologists must pause before venturing to make the popular diagnoses of the day which lead so often to unnecessary operations on the accessory sinuses.

I cannot speak for others, but for myself the subtemporal and the suboccipital operations are, in the long run, the two most useful procedures in craniocerebral surgery though, as is true of all operations, they are by no means perfected, and there are right and wrong ways of performing them.[5]

The *subtemporal decompression* I would place first on the list. It may be employed as a temporizing measure even in the presence of a localizable lesion, but it is of chief value in all unlocalizable cerebral tumors. Naturally, since the bone defect is purposefully made over the relatively silent temporal lobe, the growth may at times be unexpectedly disclosed. In the presence, moreover, of a questionable cerebellar lesion, the existing symptoms being hardly such as to justify the more elaborate and difficult posterior exposure, the measure may be used as an aid to diagnosis. For the existence of an obstructive hydrocephalus can be determined under these circumstances by a puncture of the temporal horn of the lateral ventricle, a matter of considerable localizing value, though it is to be admitted that in the presence of a hydrocephalus a decompression over the cerebrum gives but slight pressure relief.

The routine operation which may be regarded as of second importance is the *combined osteoplastic exploration and decompression*. With the boneflap so placed that its base is in the temporal region, the squamous wing of the temporal bone may be rongeured away after the flap is reflected. Though surgeons in the past have sacrificed without hesitation large portions of the calvarium in eradicating tumors, and occasionally this may be necessary even now, yet it is highly desirable that the cranial chamber should be kept as intact as one's

5. I would have felt ere this that the principles of a subtemporal decompression were so well understood that it was a safe measure in the hands of every general surgeon, but we still see so many sorry results of so-called decompression operations with bone flaps elevated in the region of the temporal attachment and often on the left side, that the happy time does not seem to have come as yet. A detailed account of the measure, long delayed in publication, has just appeared in the "Textbook of Surgical Diagnosis and Treatment," by American authors, edited by A. J. Ochsner **1**:407, 1920.

skill and the conditions permit. It is also desirable for many reasons that an operation for tumor should be conducted whenever possible in a single session, and the old two-stage performances, provided there is careful blood-stilling, are less and less frequently called for.[6]

The third procedure, the *typical cerebellar exposure,* is a still more difficult operation and necessitates elaborate preparations and skilful team work if a long series of these measures are to be carried through with a minimal mortality. In this performance the steps are practically the same, whether it resolves itself into a decompression or in the more or less complete removal of a tumor, should one be disclosed. It is a long two-hour operation at best—an hour for the full exposure and another for wound closure—but when tension is great, when there is threatened respiratory difficulty so that a ventricular puncture in the course of the early stages is called for, or when there is a recess tumor which requires long and careful manipulations, or a tumor of the mid line which necessitates removal of the arch of the atlas and prolongation of the dural incision down over the spinal canal as far as the axis, the performance may well require an extra hour or two.[7]

Since the war, influenced by DeMartel's experiences as well as by our own, I have made a few of these cerebellar exposures under a local anesthetic, and though it is possible, I do not feel that I can perform quite as perfect an operation in this way as when the patient is etherized, even though this in itself adds an element of danger. Under a local anesthetic the long seance becomes still more protracted,

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6. When a tumor extirpation is anticipated, as in the case of a large endothelioma, a two-stage operation admittedly continues often to be required for there is apt to be undue loss of blood during the elevation of the flap, and there is almost certain to be still more in a certain stage of dislodging the tumor. Under these circumstances I feel that a dural opening at the first session should be limited to the temporal region to allow a protrusion in correspondence with the subtemporal defect—in other words, with the area of bone rongeured away from under the temporal muscle. This will permit the upper portion of the flap to be replaced over an intact dura to await a second session, a certain measure of pressure relief being meanwhile secured. Should the dura be widely reflected at the first session and the tumor exposed with the inevitable protrusion of the hemisphere, this would make one of two things necessary—either an immediate attempt at tumor extirpation, which might be more than the patient could stand, or stripping off the reflected area of bone and replacement of the scalp alone, a procedure which leaves an unnecessarily large cranial defect. One may be compelled occasionally by poor judgment or force of circumstances, to accept one or another of these awkward situations.

7. A neurologist who recently had the endurance to see an acoustic tumor operation on one of his patients carried through to its conclusion with detailed wound closure, layer by layer, suddenly exclaimed: "I see now why my patients who have recovered heretofore after cerebellar operations have all had bulging necks. I had come to think it inevitable."

and by the time the patient begins to ask if you are not nearly through one can hardly resist the temptation to exceed his established speed limit, to cut corners and thereby run the risk of accidents.

These, then, are the three standard types of operation, though there are innumerable modifications of them. Each surgeon in accordance with his particular training and tastes will have devices of various kinds to overcome difficulties as they arise. These technical idiosyncrasies do not affect the three main issues—the exposure of the lesion, its safe and proper handling, the painstaking closure necessary for a wound which may subsequently be subjected to considerable tension.

I have emphasized before, and must emphasize again, that there is no field of surgery in which fastidiousness is more essential to success. Imperfections in technic in the course of operations on other parts of the body, where other tissues than those of the central nervous system are concerned, may delay recovery but not necessarily impair an end result. But corresponding slips which compromise the function of the nervous system may sometimes leave mental or other disturbances which are irrecoverable and to which death is preferable.

The surgeon who feels a due sense of responsibility regarding these difficult cases and who would reduce postoperative deformities and accidents to the minimum must often put all the reserve he has into a single operation. Without injustice to the patients more than one stereotyped measure, like a trigeminal root avulsion or subtemporal decompression, may be undertaken in a single morning, but in the case of the more arduous and uncertain procedures the physical strain and responsibility may be such that he would be foolhardy and negligent of his patients' welfare who would venture on a succession of these tasks.

Then, too, there is no group of patients who require a more detailed preoperative study, in which I feel that the surgeon is obligated to engage, and this with attention to laboratory studies which, in a new specialty, are particularly to be encouraged, is about all that can be properly attended to. It is not the number of cases operated on which have made contributions in surgery possible, but the detailed and careful analysis of the few, in conjunction with allied laboratory investigations.

Surgical technic may seem to be a thing entirely apart from the bedside study of patients preliminary to operation and from coincidental investigations in the laboratory.[8] In a certain sense it is a

8. Though there may be differences of opinion in the matter, I personally feel that for the development of surgical technic no place is comparable to the experimental laboratory, and I feel that every young surgeon should begin to acquire his operative training in a series of operations on the lower animals. Certainly in the case of neurologic operations one should learn on the

thing apart, and we are all familiar with men whose operative technic exceeds their judgment as to when it should be put to use. We have all known, too, surgeons who were somewhat awkward craftsmen but who possessed such a thorough knowledge of disease and its processes as to atone completely for their possible lack of manual dexterity. Of the two, the latter are often more safe. Surgeons with both qualities highly developed are, alas! not a common breed. The patient, unfortunately, though he pays admission, has not the privilege of viewing the performance, else he might like to see his appendix removed with a flourish, and to applause. His active interest begins when the curtain falls and he is then apt to find himself more comfortable if the audience thought it a tedious and dull show.

In the manufacturing arts, particularly in this country of ours, subdivision of labor has developed to such an extent that no workman makes a completed object. He may excel in the rapidity with which he may drive rivets, in the skill with which he may attach a given piece to an article, of whose remaining parts he has little knowledge

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lower animals the art of trephining, of the use of bone wax, of handling the cord and brain without the production of contusions and extravasations, of dealing with the cerebrospinal fluid which is the keynote of many intracranial operations. The most clever, neat and skilful of the younger generation of neurosurgeons in the country whom I have seen at work have learned their surgery of the nervous system in this way. It has the double advantage of giving them a sufficient laboratory experience to enable them subsequently to pursue to the only place where they are likely to be solved some of the many problems which arise. It was fortunate in my own case and in that of my early co-workers in Baltimore that the Hunterian laboratory was available for this purpose.

But with all this concerning the technic of operation we must not forget that there is a technic of examinations, and that a thorough, orderly and well conducted neurologic study of a patient which demands the use of many instruments of precision necessary for tests of the special sense organs, is an art in itself. The examination of the eye is unquestionably the most important of all, and without the ophthalmoscope we would be quite helpless.

But in matters of localization the perimeter is of even greater value. In the series of papers (of which one or two are still to appear) on the "Fields of Vision in Cases of Brain Tumor," published successively with Drs. George J. Heuer, James Bordley, Jr., and Clifford B. Walker, we fell into an unquestioned error in relation to peripheral interlacing of the color fields. These observations were due to inexperience, and with the highly perfected methods developed by Dr. Walker corresponding field changes were no longer observed. They were due partly to an imperfect technic, but more to erroneous interpretations of the responses of inattentive and easily fatigued patients. Naturally, therefore, color interlacing was found to disappear after operation.

Our faulty observation need perhaps not be greatly lamented for it unquestionably served to reactivate interest in perimetry which before that time, in clinics other than ophthalmological ones, was rarely employed and then only for gross defects.

and less interest. It is possible in this way, doubtless, to make a greater number of these articles and hence, if they are to be sold, to insure a greater remuneration for someone, but it does not add to the happiness or satisfaction of the artisan. On the contrary, it deprives him of the supreme satisfaction of creating something from the bottom up in which, though an artisan, he comes to take artistic pride.

This is one of the underlying sources of the unrest and dissatisfaction of the laborer. There is something of this tendency in surgery today. Ten or more goiters or hernias treated, or appendixes removed, in a morning is not an uncommon record, but none of them is completed in a thorough-going sense by one person; the chief surgeon may spend but a few moments at the task—the more essential moments to be sure, and it is renumerative—but it puts him on the basis of that form of specialist whose sole task is to give the final adjustment to the carbureter as a succession of newly-assembled motor cars pass him. This, I do not believe, leads either to real satisfaction in one's professional work or to the greatest excellence in its quality.

It was said of Godfrey Kneller, who painted portraits innumerable, that he only did the faces—others in his studio particularly skilled at portraying hands and wigs and gowns filled in the rest of the picture. The quantity was great and the canvases show it.

THE BRAIN AND ITS ENVELOPES

Tumors.—I find that in the report of 1905 no mention is made of the number of patients who up to that time had been operated on. There had been very few—twenty-nine to be exact—with no instance of a really successful tumor extirpation. The principles of decompression were under discussion and at the time it was the common practice of physicians with a brain tumor suspect—and the diagnosis was not often ventured on—to prescribe a prolonged course of antisyphilitic treatment before considering an operation. It was not until two years later, be it remembered, that the Wassermann reaction was introduced, nor was it perfected by Noguchi until 1911; but even this did not entirely remove this source of delay, for as late as 1913 at the last International Medical Congress, Horsley felt impelled to protest urgently against this form of procrastination. There are other sources of delay which today must be combated, but fortunately this one has been eliminated.

In the early days, though palliative measures brought temporary relief to many, actual recoveries after tumor extirpation were exceedingly few. There were many discouragements even on the side of the temporary alleviation of symptoms, for many patients were in the terminal stages, a large proportion of them blind, or so nearly so

that blindness ensued despite a thorough decompression. Then, too, the conditions found at necropsy in fatal cases were such as to make it seem that if cures were ever possible they would certainly be so few and far between as hardly to justify the expenditure of such labor.

Curiously enough, looking back on this early series, the first two patients who appear to have been actually cured, if one may use this term critically, both had cerebellar gliomas, and were operated on in 1908. One of them was a small boy of 13 years with a gliomatous cyst twice operated on, the last time three years later, with what appears to have been a successful destruction of the cyst wall. His functional recovery was perfect. He subsequently became captain of his school football team and now, nearly thirteen years later, is married, the father of a family, and regards himself as perfectly well. The other patient was a young man of 28, with a large glioma removed from the left hemisphere. Except for a slight impairment of vision in one eye on the recession of his choked disks, his recovery seems to have been complete, as may be appreciated from the contents of a recent letter sent me on the twelfth anniversary of his operation:

> . . . Being 39 years old, married and with two children beside other dependents, I did not feel as though I could be spared from home and so instead of enlisting in 1917 I went with the Bartlett Hayward Company who had contracts for making shrapnel shells. My particular work was making a part of the 155 mm. shell. I had to read micrometers to the one-thousandth of an inch, and if I had to depend on my left eye I could not have done it for it was already affected before the tumor was removed, as your old charts will show, but the other is normal and good enough for two. I was able to stand the hard work with the best of them though I had the "flu" and pneumonia as did lots of others. . . .

One would have thought that the initial successes would have been in extirpations of benign tumors like the endotheliomas or possibly acoustic neuromas. To be sure, the first reasonably successful operation for an acoustic neuroma—a case reported by Allan Starr—dates back nearly as far, namely, to 1909, and though the patient remains reasonably well the degree of functional recovery is by no means perfect, for though these recess tumors are benign they present exceedingly difficult surgical problems.

Doubtless in the earlier series many endotheliomas were overlooked, for, concealed as they are apt to be between the hemispheres with but little surface evidence of their presence, they are difficult to expose—at least I can only account for their present proportional prevalence by this assumption. It was not until 1910, shortly before the reading of my second paper, that I had my first really successful endothelioma extirpation with a perfect result, in a man who since that time has taken an active part in national affairs.

Though in 1910 there were only 180 tumor cases in the series, they nevertheless were beginning to appear in increasing numbers and have now become so many as to necessitate limiting the number under observation at a give time. All told, in the Baltimore series there were 330 cases up to the fall of 1912, and since then the series of of 735 cases observed at the Brigham Hospital to September 1 brings the number well above 1,000. One hundred examples of a given lesion each year provides as much material as can well be studied, and one must check the tendency to accept more than can be digested. It was far easier to comment ten years ago on 180 cases of presumed tumor than today on 1,000.

Brain tumors are common—far more so than I believed to be the case when this same statement was made fifteen and again ten years ago. The time has come when we can no longer afford to group them together as a class any more than we can group all abdominal tumors together and make a composite report on them which is at all worth while. We must take tumors in certain situations or, better still, tumors of certain kinds in certain situations, and give them special study. I have attempted to do this in a monogroph dealing with the acoustic neuromas, of which there have now been forty-five verified cases, and feel that such a group plan is the only way really to advance the subject. I shall hope ere long to follow it with a similar report on a series of some sixty verified endotheliomas which represent a particularly interesting type of intracranial tumor.

Tumor Classification.—It is an Irishism to say that other conditions sometimes resemble tumor more closely than tumor does itself. I mean by this that some of our most favorable examples of tumor are ones in which the classic symptomatic triad of headache, vomiting and choked disk is completely wanting, though all three would doubtless have appeared in time. On the other hand, many patients are admitted to the clinic with a presumptive diagnosis of tumor, of the presence of which, nevertheless, we are often extremely doubtful despite the full blown classic phenomena.

We have come, therefore, to classify the cases as (1) *tumors certified* (or verified) only when the diagnosis has been confirmed and the type of tumor identified by histologic examinations of tissue secured either at operation or necropsy;[9] (2) *tumors uncertified* when, though not histologically confirmed, the diagnosis is well nigh unquestionable; (3) *tumor suspects,* when it is a likely diagnosis. In this last group we keep a careful list also of a variety of conditions loosely designated

9. We make one exception to this, namely, in the case of gliomatous cysts the character of whose fluid contents in about 99 per cent. of cases serves to verify the character of the lesion.

as *pseudo-tumor* (though not in the meaning of Nonne), comprising states, whether so proved or not, other than tumor, but which have been sent to the clinic in view of a supposed tumor syndrome. The tentative diagnosis of some of these conditions, as other than tumor, may come to be verified subsequently at operation or necropsy, but mistakes in these borderline lesions are common and cases long classified as pseudo-tumor sometimes prove in the end actually to have been tumor cases, just as the case of an occasional patient with the diagnosis of "tumor uncertified" proves in the end to be other than a tumor case.[10]

The following greatly compressed table will show something of the numbers and give a general idea of the situation of the tumors in my complete series up to the first of September.

TABLE 1.—AUTHOR'S BRAIN TUMOR CASES

Series	Forebrain			Pituitary Including Supracellar		Hindbrain			Totals
	Certified	Uncertified	Suspects	Certified	Uncertified	Certified	Uncertified	Suspects	
Baltimore	101	51	23	41	20	53	34	14	337
Boston	146	110	62	132	52	131	72	30	735
Totals	247	161	85	173	72	184	106	44	1,072

It will be seen that of 1,072 cases classified in the tumor group, in 604, or about 60 per cent., the nature of the tumor has been histologically verified. It would lead us too far in a general address to attempt a classification of these verified lesions or to tabulate them according to their anatomic regions, though in view of their group predominance the tumors of hypophysial origin have been separately listed in Table 1. We must concern ourselves on this occasion more with the surgical than with the pathologic aspects of these conditions.

To give some general idea of the more strictly operative features of the work, the following figures of a consecutive twelve months of service ending Sept. 1, 1920, have been assembled for me. Of 182 patients admitted with a diagnosis of presumptive or possible tumor during this pereiod, the cross reference cards show that fifty-four were not operated on.[11]

10. This question of tumor classification I brought before the American College of Surgeons in an address last fall, and it is a matter which Dr. Percival Bailey has elaborated in some detail in connection with the series of cases observed during his sojourn as my assistant.

11. These may be dismissed with the explanation (1) that three patients died shortly after entering the hospital, two of them with *tumor verified* at necropsy; (2) that twenty-three are recorded as *cerebral* or *cerebellar tumor*

The remaining 128 patients were operated on in 160 sessions with sixteen fatalities, giving an operative mortality of 10 per cent., a case mortality of 12.5 per cent. and a mortality of 15.5 per cent. for the seventy-seven patients for whom a tumor extirpation, partial or complete, was attempted. Considering the gravity of many of these procedures the percentage may be considered reasonably low, but it is capable, I am sure, of being reduced by one half with earlier and more exact diagnoses.

TABLE 2.—TABLE OF OPERATIONS FOR TWELVE MONTHS ENDING SEPTEMBER, 1920

Character	Number	Fatalities
Forebrain:		
Subtemporal decompressions (palliative)	20	1
Subtemporal decompressions (disclosing tumor)	2	0
Osteoplastic exploration (cerebral)	5	0
Osteoplastic exploration (with decompression)	24	0
Osteoplastic exploration (with total or partial tumor removal)	24	5
Pituitary:		
Transphenoidal (partial removal of tumor)	20	1
Osteoplastic frontal exploration	8	0
Osteoplastic frontal exploration (total or partial tumor removal)	7	0
Osteoplastic temporal exploration	1	1
Cerebellar:		
Suboccipital exploration and decompression	25	2
Suboccipital exploration (with total or partial tumor removal)	24	6
Totals	160	16

The following additional notes of the fatalities should be given. One of them occurred in the series of twenty-two subtemporal decompressions for unlocalizable tumors. No examination was permitted and the lesion therefore remains permanently not certified.

Of the twenty-four attempts to remove cerebral tumors when exposed by an osteoplastic cranial resection there were five fatalities, four of them in the endothelioma group, as follows: of the gasserian ganglion, 1; of the falx, 1; of the mesial hemisphere, 2 (the death in one occurring several months after a total extirpation; in the other, an old man of 86 with epilepsy, it occurred from exhaustion due partly to a prostatic obstruction necessitating a suprapubic operation). The fifth fatality in this group followed the extirpation of a large glioma.

Of the thirty-six pituitary, or attempted pituitary, exposures operated on by various routes, two patients were lost, giving a mortality of 5.5 per cent. One of the twenty transphenoidal operations, an advanced case of acromegaly, died in forty-eight hours (necropsy refused). There were no fatalities in the fifteen transfrontal cases, but then, in a considerably smaller percentage in

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uncertified, one of these the third of the fatal unoperated cases; (3) the remaining twenty-eight cases are cross-indexed as *tumor suspects* and represent a great variety of conditions with such presumptive diagnoses as encephalitis, arteriosclerosis, aneurysm, cerebral syphilis, and so forth. In this group of twenty-eight there is only one case in which the lesion so far has been transferred from the tumor suspect to its proper group owing to verification of the lesion: a blind child with symptoms I had thought to be due to an infundibular tumor with hydrocephalus, but which proved to be due to a thrombosis of the superior longitudinal sinus.

this than in the transphenoidal group, the operation was successful in its purpose. The single attempt to deal with an interpeduncular tumor from the side was fatal, presumably from postoperative cerebral edema, a consequence of the dislocation necessary to secure a sufficient exposure.

Of the twenty-five suboccipital explorations for presumed cerebellar lesions, the two deaths occurred in cases of mistaken tumor localization, one that of a child with secondary hydrocephalus due to a bilateral papilloma of the choroid plexus, the other a patient with a large diffuse cerebral glioma.

Six of the twenty-four patients with cerebellar tumor succumbed after a more or less complete tumor extirpation; one of them three weeks after operation, following a fall causing contusion and hemorrhage; another a patient with an acoustic tumor who also had exophthalmic goiter and who died of weakness on her twenty-eighth day; another an acoustic tumor extirpation with death from inhalation pneumonia on the fifteenth day. The fourth patient died on the second day of respiratory paralysis after a partial removal of a glioma from over the fourth ventricle; the fifth died suddenly on the third day, after a thorough evacuation of multiple cysts due to a chronic arachnoiditis (pseudo-tumor, verified); the sixth patient died six weeks after an apparently successful extirpation, intact, of a tuberculoma.

The highest mortality, therefore, in this twelve months' series was in the suboccipital group of forty-nine operations with eight fatalities, giving a 15 per cent. mortality, or a 25 per cent. mortality for the cases in which tumor extirpation had been attempted. In this particular respect the record for the twelve months was a bad one, but the high percentage is due to the inclusion of the three patients who died some weeks after the operation from causes not directly attributable to it. Were one justified in eliminating these three cases the mortality would fall one half, which is about where it should be.

Needless to say, in this entire series there has not been a single case of wound infection. One of my assistants, who had served in the hospital for over two years, had seen a fungus cerebri only in pictures until he went to France with our hospital unit and met with this condition for the first time in the cases of cranio-cerebral injury to gunshot wounds.

Pituitary Disorders.—In my address of 1905 there is a footnote to the effect that conceivably a diseased pituitary body might some day be successfully attacked. How little was understood of pituitary disorders at the time can be appreciated from the fact that not until a year later (1906) was the first example of an infundibular tumor recorded in the Johns Hopkins series, and though a diagnosis of tumor with hydrocephalus was made, we had not the faintest idea of the location of the lesion. When this was disclosed long after at necropsy we had, even then, no inkling of the disturbances of metabolism the tumor had provoked.[12]

Today the diagnosis of so-called adiposogenital dystrophy, particularly when due to a supracellar tumor, would be made at sight by an undergraduate, for the clinical aspects of pituitary insufficiency

12. This case, with one other, was reported under the title "Sexual Infantilism with Optic Atrophy in Cases of Tumor Affecting the Hypophysis Cerebri," J. Nerv. & Ment. Dis. **33**:704 (Nov.) 1906.

when once pointed out prove to be as striking as those of cretinism or myxedema. Chagrined as we were by this experience, it nevertheless served a good purpose since it made possible an interpretation of the experiments undertaken the following year in the Hunterian Laboratory with S. J. Crowe and John Homans. For in the course of some experimental canine hypophysectomies, the counterpart of these clinical states, showing that they are due to a deprivation of pituitary secretion, was unexpectedly hit upon.[13]

From this small beginning it has come about that hypophysial disorders are now recognized almost as often as those of the thyroid, and there is no reason to believe that one of these two glands is affected by disease any oftener than the other, though in view of the exposed seat of the thyroid the diagnosis may be read from afar.

In March, 1909, I first ventured to operate for a pituitary tumor in a case of acromegaly, employing a modified transsphenoidal approach to the sella, the result of abundant studies on the cadaver. The procedure was merely a further development of the operation by way of the nose, first used in its crudest form by Schloffer, the chief modifications making it possible to avoid nasal deformity and to lessen the likelihood of a postoperative infection. The case was a fortunate one [14] and led me to develop the operation by this route still further, though fully aware of its limitations, for it is only appropriate to those cases in which there is a wide dilatation of the sella.

At the time of my second address in 1910 there had been twenty cases under observation, and the following cautious expression of opinion was given:

> No one as yet would venture to assert that a tumor in the infundibular region can be totally removed, and inasmuch as pituitary headaches and pressure against the chiasm may be relieved by a local decompression or by the chance evacuation of a cyst, it would seem wise for the present at least, in view of the importance of the gland, to confine operative measures in most cases to the mere removal of the sellar base with incision of the glandular capsule—a local decompression.

A further statement expressing conservatism was made to the effect that "hypophysial tumors which have extended from the infundibular region into the cranial chamber proper must be treated by the same rules of decompression as would be applied to any equally inaccessible lesions elsewhere."

Time has shown that the former statement was unnecessarily cautious for in most transsphenoidal operations a considerable amount

13. Clinical Aspects of Hyperpituitarism, J. A. M. A. **53**:249 (July 24) 1909.
14. Partial Hypophysectomy for Acromegaly, Ann. Surg. **1**:1002 (Dec.) 1909.

of tissue is removed. In the latter statement I was quite wrong, for a subtemporal decompression rarely benefits a patient suffering from pituitary headaches, for they are due to local rather than general pressure effects. Hence when an adenomatous gland has penetrated its dural envelope and invaded the cranial chamber, it must be surgically approached from above, if at all, by an osteoplastic exposure of the region.

In a monograph on pituitary diseases, published in 1912, after a general discussion of the subject, my forty-three surgically treated cases were recorded. I had had but a single experience at the time with osteoplastic temporal procedures, such as Horsley had practiced, and none with the approach from in front by elevating the frontal lobes as originally proposed by Hartley and McArthur.

With our increasing familiarity with pituitary tumors, however, the cases with an indubitable infundibular lesion surmounting a more or less normal sella, which would preclude an operation from below, came to be so often recognized as to necessitate the employment of some osteoplastic measure, and the frontal procedure was given preference. Since my first case (Dec. 12, 1913), a considerable number of these operations, occasionally with a gratifying result, have been undertaken. Recently Heuer and Dandy in Baltimore and Adson in Rochester have warmly advocated a development of the lateral approach, first employed by Horsley. Unquestionably there is no one operation suitable for all cases, but I feel that the postoperative complications and high mortality, approximating 40 per cent., which so skilful an operator as Dr. Huer admits,[15] in view of the scant promise of permanent cure on recovery, will deter others from adopting this procedure.

In general terms, it is my present opinion that when there is a primary pituitary adenoma with enlargement of the sella and signs of implication of the chiasm, the operation of choice is a transsphenoidal one. Properly conducted, it is an operation of comparatively low mortality,[16] convalescence is a matter of a few days and the results are

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15. Heuer, G. J.: Surgical Experiences with an Intracranial Approach to Chiasmal Lesions, Arch. Surg. **1**:368 (Sept.) 1920.

16. At the time of writing my monograph on the "Pituitary Body" in 1912 there had been twenty-nine transsphenoidal operations with four deaths (13.7 per cent. mortality). By the time of the Weir Mitchell Lecture (J. A. M. A. **63**:1515 [Oct. 31] 1914) on "Surgical Experiences with Pituitary Disorders" there had been to May 12, 1914, seventy-four of these operations with seven fatalities (9.5 per cent. mortality). A review of the cases since then shows an additional eighty-three operations with eight fatalities (9.8 per cent.), making 157 transsphenoidal operations in all with a mortality of 12.1 per cent. for the entire series.

often brilliant, with restoration of vision—the main object of the operation—which may be astonishingly rapid. However, as Dr. Heuer points out, it is not an operation which is likely to be repeated with equal success (true enough of any operation) in case the adenoma continues to grow rapidly or has already broken down the dural barriers and invaded the cranial cavity. Under these circumstances, if an operation is to be done at all, it must be from above if there is to be any prospect of preserving or restoring vision, and this—an improvement in vision—not mere operative recovery, is our present criterion of a successful procedure.

It is very doubtful, however, at an early stage of a primary intrasellar adenoma when the conditions are favorable for an operation through the nose, whether patients should be urged to, or would be willing to, submit to an operation from above, with its admitted high mortality and likelihood of complications. For it is accompanied by a wide exposure of the brain whose cortex may suffer injury as may indeed the chiasm itself, and the operation furthermore opens the dural barriers so that further enlargement of the growth finds ready access to the region we would wish to protect.

With primary infundibular tumors surmounting, as they often do, a small sella of normal proportions, the problem is entirely different, and I am led to favor, with some modifications, the unilateral osteoplastic frontal operation. In the thirty-four patients with operations of this type (forty-three in number) there have been only two fatalities, the second and third cases. However, in only seventeen of the thirty-four patients was the lesion disclosed, and it could not be satisfactorily dealt with in all of them. In 50 per cent. of the cases, therefore, the nature of the lesion remains uncertified.

In a few cases, nevertheless, the results have exceeded all expectations, and it has been possible to enucleate small solid tumors or to empty a cyst and subsequently to detach and draw out its collapsed sac. But I must confess that it is not an operation to be made light of, and I have occasionally added to the preexisting damage of the optic nerves. Indeed it has been necessary once or twice to divide the functionless one of the pair in order to dislodge the growth. In the case of the pharyngeal-duct cysts, a condition which would seem most favorable, the results have been disappointing, for the cysts promptly refill unless the wall is fully removed.

The fight for vision is the crux of these operations, and, after all, the question of proper methods we neurosurgeons must settle among ourselves, not by writing papers but by seeing one another's cases and attending one another's clinics. Meanwhile neurologists and physicians who have the decision to make may be comforted by the fact that the

majority of these operations can be performed with a comparatively low mortality and a degree of symptomatic improvement which is constantly increasing.

Patients with disorders of the ductless glands, of the hypophysis in particular, show more or less characteristic mental attributes not necessarily deviating widely from the normal. I was inveigled once into writing an article on the subject, and whether from this or from some other beginning certain practitioners calling themselves endocrinologists have erected an extraordinary structure of symptomatic complexes based on meager evidence and a fervid imagination. This has reached its climax in a recent monograph by a psychiatrist, Laignel-Lavastine. There is no way apparently of checking these elaborations, which bear about as much relation to the functions of the ductless glands as did the phrenological imaginings of Gall and Spurzheim to cerebral localization. Epidemics of this sort from time to time hysterically sweep over Medicine, dying out in due course, the more quickly if unmolested.

Studies on the Cerebrospinal Fluid Circulation.—It is true of all intracranial operations that in the knowledge of ways and means of controlling tension lies the secret of surgical success. Intracranial over-tension is largely a matter of an increase in the fluid content of the chamber, whether it exists as free fluid in the ventricular and arachnoid spaces or as an edema, a state to which the nervous tissues are particularly prone. Though formerly the extensive withdrawal of fluid was looked on with apprehension, it has come to be an essential step in many cranio-cerebral operations, during the course of which the fluid, either from ventricles or arachnoid spaces, is not only thoroughly evacuated but may be permitted to drain away during the course of a long operation. There may be ways other than by external drainage of accomplishing the same thing, but to this we will return.

One of the problems which confronts the neurosurgeon is some method of dealing with the disturbances of cerebrospinal fluid outflow which lead to such malformations and disorders as spina bifida and "essential" hydrocephalus. In the latter condition, operations innumerable have been advocated since the earliest time, none of them proving to be based on correct principles if one may judge from their lack of success in practice. I have always cherished the view that most of these hydrocephalic conditions were produced by some failure of development of the points of escape for the fluid from the cranial chamber rather than, as was long supposed, from a fault or obstruction at the foramen of Magendie. The fact that in most cases the fluid could be withdrawn from the ventricles by a lumbar puncture, in other words, that it had access to the subarachnoid spaces, certainly seemed to favor this view.

Some early studies on hydrocephalus were carried out in the Hunterian Laboratory with Walter E. Dandy in 1910-1911. It was found possible not only to catheterize the aqueduct of Sylvius but to produce an experimental hydrocephalus by mechanically obstructing it. At the same time some early attempts were made to investigate the functional activity of the plexuses but we did not get very far with them.[17]

It became apparent that it would be necessary to carry our studies to the meninges if we were to find the most likely sources of obstruction. This work was undertaken by Lewis H. Weed in conjunction with Paul Wegeforth in the Surgical Laboratory during my first two years at Harvard. In the introductory notes to the series of reports on this work[18] a statement of the problems we had set ourselves to solve, so far as time would permit, is as follows:

> . . . Granting that the choroid plexuses are the chief source of the cerebrospinal fluid—and this has not been conclusively proved—is the process, as some believe, a transudation, or an actual secretion, or, as Mestrezat regards it, a mere dialyzation from the blood? What conditions activate and what conditions inhibit these choroidal glands? Have they an internal as well as an external secretion? To what primary diseases are they subject? How early in embryonal life do they secrete? Why does the fluid which they elaborate differ so greatly from that secreted by most other glands? Why are the cells so impermeable to the passage from the blood stream of drugs and of substances such as the bile pigments which, in conditions of jaundice, quickly stain all other body tissues and fluids?
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> Granting that the fluid thus secreted by the choroid plexuses leaves the ventricles and spreads over the brain and down the cord in the subarachnoid spaces, does it receive accessions from elsewhere, from the ependyma or from pituitary or pineal glands? Are there lymph channels in the brain, and if not, how does the central nervous system dispose of its products of tissue waste? If there are cerebral lymphatics do they discharge into the subarachnoid spaces and is the subarachnoid fluid therefore of the same character chemically, physically, and cytologically as the ventricular fluid? Why normally is the fluid practically limited to the subarachnoid spaces, and under what conditions does it become subdural?
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> Granting that fluid may escape by way of the Pacchionian granulations, is this the chief or only manner of escape? If an important avenue, why are these structures lacking in the lower animals and in the human infant? Are these granulations therefore pathologic processes, and if so what are their precursors? Are there other means of fluid absorption along the nerves by way of the lymphatics, and if so how important are they? How do the spaces

17. Dr. Dandy has recently reported the results of these and some more elaborate subsequent studies which he undertook independently. By an ingenious method he has been able to show quite conclusively that the fluid is elaborated by the plexus without the ependyma taking any part in it. Experimental Hydrocephalus, Trans. Am. S. A. **37**:397, 1919.

18. Studies on the Cerebrospinal Fluid and Its Pathway, J. M. Res. **31**:1, 1914.

in the pia-arachnoid develop and do the choroidal glands mature and secrete before or after their formation? Are there faults of development at these meningeal outlets for fluid which can account for congenital cephalocele? Are there analogies in the fluid circulation of the eye to which we may attribute the disturbances of circulation of the intra-ocular fluids?

Weed, by adapting the principle of injection of nongranular fluids from which granules might subsequently be precipitated, showed conclusively that the arachnoid villi represent the points of escape for fluid which, by a process of seepage, enters directly into the pachymeningeal sinuses. It was, I believe, Wegeforth's proposal that in cases of hydrocephalus a series of direct punctures be made directly through the sinuses into the subarachnoid spaces, under the assumption that the puncture holes would become occluded by arachnoid, making thereby new and artificial villi through which fluid might escape.

Weed's continuation of these studies on his return to Baltimore and his demonstration of the manner of development of the fetal arachnoid spaces which I assume (though the point remains to be proved) to take place when the choroid plexuses first begin to secrete actively, certainly stands as the most important contribution to our knowledge of the meninges since Key and Retzius.[19]

If it is true that most cases of congenital hydrocephalus can be accounted for by a faulty development of the villi, the rational treatment is to reproduce in some way this channel of outflow either by direct drainage into one of the larger sinuses or by encouraging the formation of new villi in the manner Wegeforth suggested, rather than by an attempt to check the formation of fluid.[20] At least it is along these lines that our surgical efforts have tended of late years. Certainly no form of drainage into tissue spaces is effective, for by a curious property of the extracranial tissues when they are made edematous by cerebrospinal fluid leaking into them, a smooth endothelial-lined sac ultimately forms which is impervious to the further escape of fluid.

Such a procedure as Dandy has shown to be surgically possible, namely, the excision of the plexus from within the dilated ventricle,

19. The Development of the Cerebrospinal Spaces in Pig and Man, Contributions to Embryology No. 14, Carnegie Institution Publications No. 225, 1917, p. 116.

20. In his more recent paper (The Diagnosis and Treatment of Hydrocephalus Resulting from Strictures of the Aqueduct of Sylvius, Surg., Gynec. & Obst. **31**:340, 1920), Dandy estimates that 66 per cent. of all cases of congenital hydrocephalus are due to Sylvian obstruction. If this is true the agency of obstruction to which we have devoted attention is less common than we had supposed.

can hardly be expected to serve the desired purpose, for if there are any remaining fragments of plexus (and it is a complicated organ) the same degree of tension should recur so long as the ultimate outlets for the fluid are defective.[21] Possibly no more conclusive argument than Weed's more recent paper [22] could be given favorable to the view that imperfect formation or occlusion of the villi is one source, if not the most common one, of what has been called idiopathic (for lack of understanding of the process) hydrocephalus. By injecting a suspension of lamp-black into the cerebrospinal spaces of kittens, he was able to produce extreme degrees of internal hydrocephalus quite comparable to similar conditions seen in human infants.

At the present moment there are two or three new proposals before us which have a bearing on the cerebrospinal fluid and its spaces, and though admittedly still in an experimental stage, one or all of them may come in time to have considerable importance from a diagnostic as well as therapeutic standpoint.

In a recent paper, which has aroused great interest,[23] Dandy has put forth some very definite claims regarding the localizing value in cases of brain tumor, of what he calls *ventriculography*. This is, in other words, the taking of roentgen-ray plates of the cerebral ventricles after their fluid contents have been removed and replaced by air.

It is quite certain that in some rare conditions a more exact localizing diagnosis might be made in this way than in any other, and, in the case of tumors situated in silent areas above the tentorium which have led to dilatation as well as deformation of one of the ventricles, perhaps only in this way. That the procedure may be sufficiently developed and safeguarded so that it can be routinely utilized for this purpose is quite within the realms of possibility.

One particularly striking case has been included in Dandy's report, whereby an unsuspected tumor in the right occipital lobe was disclosed, though one must confess that it might have been capable of localization by earlier and more exact perimetry. However, as I have stated,

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21. Grave doubts have been expressed by workers in Carlson's laboratory as to the justifiability of the common assumption that the plexus is an active secretory organ and therefore that there is such a thing as a cerebrospinal fluid circulation (Becht, Frank C., and Matill, P. M.: Am. J. Physiol. **51**:1, 1920). If they are correct and we wrong, our entire theorem falls to the ground.

22. The Experimental Production of an Internal Hydrocephalus, Contributions to Embryology No. 44, Publication No. 272, Carnegie Institution, 1919, p. 425.

23. Dandy, W. E.: Localization or Elimination of Cerebral Tumors by Ventriculography, Surg., Gynec. & Obst. **30**:329, 1920.

the procedure is in an experimental stage and surgeons may safely leave it in Dr. Dandy's hands to work out more thoroughly its possibilities as well as its hazards, as he doubtless intends to do; and it would be highly desirable under these circumstances for every one who undertakes the procedure to notify its inventor of their experiences and particularly of the accidents. In this way only will he be able to establish the proposal on a safe basis acceptable to others, as all hope that he may be able to do. That there have already been a goodly number of fatalities, doubtless in the hands of people less expert than the author of the method, is well known. It will soon have a bad repute if so much is expected of it as is given in the author's conclusions, and if the surgeon is encouraged to believe that henceforth he will have less need of exercising his neurologic knowledge in localizing brain tumors.

Another procedure likewise in an experimental stage, though capable, it is hoped, of further development, is the diagnostic *puncture of the cisterna magna,* a procedure worked out in the Army Neurological Laboratory under Dr. Weed's direction during the war, and which has subsequently been warmly advocated by James B. Ayer.[24] When one realizes how loath the profession was to adopt Quincke's lumbar puncture as a more or less routine measure, one hesitates to say that a suboccipital puncture will not some day come to be as commonly employed. However, even a lumbar puncture is not without risk, as those are well aware who have seen patients with unrecognized cerebellar tumors die from respiratory paralysis soon after one has been made; and the risks of a puncture of the posterior cistern under similar circumstances would be infinitely greater. Hence this procedure, like the foregoing, had best be left in the hands of its sponsors until they can give us complete details not only of the method but of its diagnostic and therapeutic possibilities, and above all of its hazards.

But probably the most suggestive papers issued by this laboratory during its short life were those by Weed and McKibben[25] on the experimental *alteration of brain volume* following the intravenous injection of various substances in solution. They observed that, after the cortex was exposed by a trephine opening, the intravenous injection of a watery solution caused the brain to protrude through the

24. Wegeforth, P.; Ayer, J. B., and Essick, C. R.: The Method of Obtaining Cerebrospinal Fluid by Puncture of the Cisterna Magna (Cistern Puncture), Am. J. Med. Sc. **157**:789, 1919.

25. Pressure Changes in the Cerebrospinal Fluid Following Intravenous Injection of Solutions of Various Concentrations, Am. J. Physiol. **48**:512, 1919; Experimental Alteration of Brain Bulk, ibid., p. 531.

opening, and contrariwise, that a hypertonic salt solution caused it to recede, sometimes to a very extraordinary degree.

That these observations had great possibilities of clinical application was immediately apparent to all, and Dr. Foley and others in my clinic have made it a matter of special study.[26] They found, in the first place, that it would answer almost as well to give sodium chlorid by mouth, and it is at times quite amazing to see what an immediate symptomatic effect, particularly when there is increased intracranial tension, this simple procedure may have.

That it is not entirely free from risk we have reason to know, but that it has great future possibilities of applicattion we nevertheless are encouraged to believe, though here again it is a matter of slow painstaking observation on the part of a few rather than indiscriminate observations on the part of many, which in time will establish its therapeutic and diagnostic possibilities and risks. As has been realized for a long time, the application of biophysical knowledge to the problems relating to the nervous system promises large returns, and Weed and McKibben's studies lie in this direction.

It would be premature to pass on the future rôle which any one of these three measures I have mentioned may come to play. Let us hope that they will not suffer a wave of wild popularity, to be cast off like von Bramann's callosal puncture, as good for nothing, simply because it could not do in others' hands everything and more than its author claimed for it.

THE SPINAL CORD

I have read over the general statement in my papers of ten and fifteen years ago regarding the surgery of the spinal cord, and though I might give many additional illustrations I do not know that there is very much to add to the general principles of these operations then described. There are more things, possibly, to retract than to add.

Infections.—In 1910 Flexner's serum for cerebrospinal fever had just been introduced and held the stage, but I fear that we are no further advanced in our treatment of other forms of meningeal infections than we were at that time, though proposals for irrigation and drainage of the meningeal spaces recur at more or less frequent intervals.

Great hopes were aroused, particularly from a prophylactic standpoint, by Crowe's discovery of the passage of hexamethylenamin through the choroid plexuses and its prompt appearance, after admin-

26. Foley, F. E. B., and Putnam, T. J.: The Effect of Salt Ingestion on Cerebrospinal Fluid Pressure and Brain Volume, Am. J. Physiol. **53**:464, 1920.

istration by mouth, in the cerebrospinal fluid. We did not know at the time that it appeared unchanged, and that only in an acid medium like the urine was it broken up with the liberation of formaldehyd. Crowe's observations, however, on the efficacy of the drug, particularly as a prophylactic, in experimental canine meningitis were nevertheless so convincing that we have continued with its use in certain conditions —in patients with basal fracture, before transsphenoidal pituitary operations, and so on. It certainly does no harm, though we may have been leaning on a broken reed.

In view of the fact that most of these pathogenic cocci are acid producers I have harbored the idea that in process of their multiplication enough acid may be given off by them to liberate a certain amount of formaldehyd in their immediate vicinity, without producing an appreciable change in the reaction of the fluid as a whole—in short, that in this way, even though the cerebrospinal fluid retains its faintly alkaline reaction, the growth of organisms may nevertheless be locally inhibited. We have attempted by physicochemical tests to demonstrate the truth or otherwise of this conjecture, without any really definite conclusions.

Tumors.—As stated before, there is no more satisfactory operation in surgery than the removal of an accurately localized endothelioma of the spinal meninges—no operation unless it be for some of the major trigeminal neuralgias, in which the transformation from a suffering and bed-fast invalid to a normal life is more like resurrection. One may imagine the elation which Horsley and Gowers must have felt in 1888 on the occasion of their epochal first case.

My experience with these enucleable tumors has not been great—only seven cases additional to the one mentioned in my 1905 address which had been reported elsewhere.[27] Of many things I have learned in fifteen years, one is to beware of reporting "cures." This man had a recurrence of his symptoms, and some years later, at a secondary operation, a growth was disclosed which to all appearances might have been the primary one. On this second occasion it was removed, together with the subjacent patch of meninges, and there has since been no recurrence. The lesson was thereby learned that it does not do merely to tilt these lesions out: their meningeal attachment from which they take origin must also be removed, and this is not altogether easy since the central point of attachment seems invariably to be at the point of emergence of a segmental nerve root.

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27. Intradural Tumor of the Cervical Meninges with Early Restoration of Function in the Cord After Removal of the Tumor, Ann. Surg. **39**:935 (June) 1904.

It is astonishing how promptly it begins and how great a degree of functional recovery is possible in the flattened cords long subjected to pressure by such a tumor. What is more, the promptness with which this restoration sets in may be taken as an evidence of the delicacy with which the tumor enucleation has been conducted. The last of these patients in the series gave the history of having had a cancer of the thyroid removed in 1900 and in 1903 a cancer of the breast; consequently when her spinal symptoms began to appear a few years later they were naturally attributed to a metastasis. For this reason an exploratory operation was thought inadvisable, and she gradually became bedridden from paralysis. However, the results of a neurologic examination, coupled with the characteristic manner of onset of the symptoms, were so unmistakably in favor of a spinal endothelioma that an exploration was urged and the expected lesion found and removed. Voluntary movements in her previously paralyzed extremities were possible the afternoon of operation, and before her discharge she was walking with slight assistance and now, a few months later, goes about alone.

From these brilliant results, which are all too few, there is a long gradation of less and less favorable cases to the malignant growths at the other end of the scale. No sufferers so greatly tax one's sympathies as the victims of malignant spinal metastases, and in 1910 I find that I had even suggested "the deliberate transsection either of the entire cord or of the posterior columns alone, cephalad to the lesion." The alternative of pain or complete permanent paralysis is hard to face, for patient as well as surgeon, and it was one which I had shrunk from until a few years ago, though fully aware that the victims of a transsection the result of a crush usually lead an existence free from pain and surprisingly often take a curiously detached and philosophic view of their plight. This peculiar dispositional attitude of mind has seemed, in short, to be a mental attribute consequent on the abolition of all impulses from the lower body.

Much against my wishes, there was admitted to the wards in 1916 a woman suffering great pain from an obvious spinal metastasis, attributable to a breast amputation for carcinoma performed twenty-five years before. As her paralysis below the twelfth thoracic level was nearly complete, it did not seem possible that she could live long. For months her pain had been controlled by morphia, which seemed the only recourse. She, however, held out for months, courageous and cheerful though begging for some operative relief, until finally with many misgivings I divided the cord in the more accessible thoracic region well above her lesion. The results far exceeded both the

patient's and my own expectations. She had no more pain whatsoever, narcotics were completely withdrawn, she gained in strength and color, acquired an automatic bladder control and lived in really great comfort, bodily and mental, despite what she knew to be in store for her. The end came six months later—the easiest and happiest end in a case of this kind of which I have cognizance.[28]

Akin to this, though less radical and advocated for less critical conditions, are other palliative measures which have been put in practice. Förster's posterior root division in cases of tabes, which is but a development of the old operation advocated for intractable neuralgias of amputation stumps, is one example: another is the procedure which Frasier and Spiller have described, of dividing the anterolateral columns alone, a procedure similar to that which I suggested in 1910, though based on more accurate localization of the pathway for pain.

Trauma.—What was said on this score from a surgical point of view in my first paper I do not think I can now improve on—the division into (1) the hematomyelias, (2) the total cross-lesions usually from fracture dislocation, and (3) the partial injuries, these being the only ones suitable for surgical intervention. The difficulty lies in distinguishing the three groups, and one must acknowledge that there is no sharp dividing line between them. In this respect, however, we will have learned much, chiefly through a study of the victims of spinal gunshot wounds in the late war, though it will probably be a long time before all the material is thoroughly studied. Placed as some physicians were, Colonels Sargent and Holmes, for example, at one of the important British bases, it was possible to secure specimens for later study of lesions of practically every segment of the cord in a series of cases which had been previously subjected to a thorough neurologic study. Madame Déjerine's opportunities with the spinal injuries occurring in the French army were almost as favorable, and she has already published some extraordinary observations concerning ossification of the muscles in areas below the segmental level of the lesion.

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28. Her death occurred while I was overseas, where the following letter was received from her husband. It may deserve quoting in view of the rarity of such procedure. ". . . After the operation she was brought home in May, and was enabled to enjoy the birds and flowers and go out in a wheel chair. She finally very slowly yielded to the disease, passing from us October 31, nearly a year from the time she entered the hospital. She was cheerful and patient during all her illness but beyond digestive troubles she had little pain and nothing acute. . . ."

Many remarkable and unknown facts were brought to light regarding the localization of function in the cord, but possibly the most immediately arresting were the studies of Henry Head and his coworkers.[29] Their observations have shown that, even when in its cross extent the lesion has been anatomically complete, the cord distal to the lesion is capable of resuming its reflex function to a degree hitherto unappreciated. This process, in the absence of infection, begins to set in after the third week, at which time the lower spinal reflexes begin to reappear. Hence the old conception of a permanent loss of deep reflexes with flaccid paralysis as an indication of a total transsection falls to the ground.

Though these observations are of great importance in advancing one's physiological knowledge, they do not necessarily affect in any apparent way our surgical procedures, except to influence surgeons to favor in every way possible the return of the so-called automatic bladder reflex which enables the unfortunate victims of these injuries to hold their urine for a few hours at a time.

This involves a problem relating to the care of these patients for which the war does not seem to have given a satisfactory answer, namely, the correct method of dealing with the bladder in the early stage of retention. The main desideratum, if one hopes to attain for his patient a subsequent automatic bladder control, is the avoidance of infection, and whether a constant drainage by catheter from the outset, repeated catheterization, suprapubic drainage, or the avoidance of any direct interference whatsoever and letting the bladder distend till it dribbles—which of these methods is best, no one so far as I am aware was ever able satisfactorily to determine, nor in this generation, will we again, let us hope, have so good an opportunity of finding out.

One thing the observations of Head have served to explain are the mystifying reports which have appeared in the literature from time to time regarding the restoration of function in a completely severed spinal cord after a laminectomy and suture. Unquestionably they were faulty observations to be explained by the reappearance of these lower spinal reflex movements which were erroneously interpreted as an evidence of transmission of impulses from above.

THE PERIPHERAL NERVES

The surgery of the peripheral nerves, other than cranial, belongs largely though not entirely in the domain of traumatic surgery, and as injuries of the larger nerves are often coupled with deformities and

29. Fearnsides, Head and Riddock: Brain **40**: Pts. 2 and 3, 149, 1918.

need what is called physiotherapy, together with some supporting apparatus in their after care, a bid for these lesions during the war was made by the orthopedists.

It was calculated that fully 25 per cent. of all major injuries of the extremities were accompanied by a more or less serious involvement of important nerve trunks, and it makes little difference who cares for them—if an orthopedist, he must have a better neurologic training and operative technic than most possess; if a neurosurgeon, he must familiarize himself more than he is accustomed to with the mechanical correction of paralyses. The subject at all events received a great fillip during the war, and much has been learned and much unlearned regarding nerve sutures. Attention may be called to a few points which stand out clearly from the great number of published observations.

It has long been known that divided nerves, given half a chance, tend to reunite. Indeed, under circumstances when a purposeful section or avulsion of a nerve has been made it is well nigh impossible at times to prevent some degree of functional reunion. This the old-time peripheral operations for facial neuralgia made only too clear. What takes place has been more or less a subject of academic dispute between the supporters of the neuron doctrine and those of Bethe's school who believed in the possibility of a peripheral regeneration of axons. Though Bethe undoubtedly found axons in the peripheral segments, Langley's explanation of their presence was doubtless the correct one. In short, the proliferation of the cells of the neurilemma sheath is the only peripheral process and though this prepares the way for the axon, unquestionably the axis cylinder must grow down from the proximal segment.

From the great mass of material of the past few years the curious observation was soon made that certain nerves show a much greater tendency to perfect functional reunion than others. To take a single example, the prognosis after injury and suture of the musculospiral was far better than after a corresponding injury of the median. This appeared, moreover, to have no relation to the distance between the seat of the injury and the periphery, for a high radial suture was more favorable than a low median. The explanation for this which seems best to meet the facts is that the functional recoverability bears relation to the degree of purity, whether sensory or motor, of the nerve in question. Thus the musculospiral nerve has a great preponderance of motor fibers and consequently after suture there is less chance of motor axons finding their way down sensory pathways and the reverse than if the number of sensory and motor fibers were more nearly equal, as is true of the median.

This at least is the interpretation which appears best to fit the facts before us, though it is one which is difficult for me to believe as it seems a poor provision of Nature. Though we have little knowledge of what the nerve impulse really is, much less of the distinction between a motor and sensory impulse, there certainly must be some chemical difference between the two nerves which would lead us to assume a predilection of down-growing sensory axons for sensory paths and motor for motor.

Be this as it may, it is assumed that, when an imperfect functional result follows what seems to be a simple and perfect nerve-suture as so often happens after median nerve sutures, the majority of motor fibers have grown down into sensory sheaths to sensory end organs whose messages they are incapable of transmitting, and the majority of sensory fibers likewise to motor end organs.

This interpretation may be quite wrong, though as I say, it seems to fit the facts and, if correct, it would appear to favor such detailed operative procedures as Elsberg has described, based on Déjerine's studies of the cross sectional topography of bundles in the peripheral nerves. However, even if it is surgically possible to approximate a divided peripheral nerve, bundle for bundle, in the process of a nerve suture, which I doubt, there is something other than end-to-end proximity—and it is only a matter of millimeters—which attracts the wandering axon into some particular peripheral tube. Indeed one may see a perfect functional result when an actual (though small) gap has been left, or contrariwise, an imperfect result with the most painstaking approximation.

One thing has been made clear beyond question, and that is the supreme desirability of bringing the two ends of the severed nerve together without the interposition of a bridge, and ingenious ways and means of accomplishing that have been devised, not only by stretching and by mobilization of the nerves, but by shortening the gap in case of great loss of substance by retaining the limb in a position of acute flexion until union has taken place.

Losses of substance of several inches can be overcome in this way, and it has meant the abandonment of the pre-war ideas regarding tubularization and implantations as a means of overcoming gaps—procedures which by increase in scar formation doubtless served to defeat the very object they were intended to serve. To be sure, there have been some remarkable recoveries, particularly in musculospiral nerves after the implantation of nerve autografts,[30] and Nogeotte, whose experimental studies have been extensive, favors the implanta-

30. Madame Déjerine informed me of a perfect result in a French officer in whom a gap of 7 cm. was thus bridged.

tion, if one must be made at all, of a section of nerve from another source (homograft), which has been fixed in alcohol, but of this I have no experience.[31]

Unquestionably, interest in all these matters aroused by the war has turned the attention of many of our younger surgeons with renewed interest to some of the neurologic problems of surgery. Brief courses were given in New York, Philadelphia and St. Louis, largely under the direction of Drs. Elsberg, Frazier and Sachs—which served further to concentrate attention on the subject and to give certain medical officers, whose inclinations lay in this direction, some general ideas of traumatic neurosurgery.

Excellent as all this was, it is a far cry from traumatic to pathologic surgery, from doing a peripheral nerve suture to a trigeminal neurectomy, from the repair of a cranio-cerebral injury to the removal of a brain tumor. Then too, the lack of personal responsibility about one's army patients— a responsibility entirely assumed by the Government—coupled with the difficulty or impossibility of learning of one's end results, did not inculcate in many medical officers the fastidiousness of clinical study or operative technic which is a *sine qua non* of success in civil surgery and above all of civil neurosurgery.[32]

A National Institute of Neurology.—Though as a matter fact it was the first time that such a special line of work as is represented by neurosurgery was recognized by an Army Medical Corps, the

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31. The conclusions of G. Carl Huber, Dean Lewis and others (Repair of Peripheral Nerve Injuries, Surg., Gynec. & Obst. **30**:464, 1920) in relation to the bridging of gaps seem to be very much in accord with those of Nogeotte.

32. I have not touched on the *surgery of the cranial nerves,* as this address is already too long. There are many interesting and important aspects of this topic, though possibly the surgery of the *trigeminus,* and of trigeminal neuralgias in particular, overshadows all else in this particular domain.

I have made these major neuralgias the subject of a recent study, and the results, given a year ago in the Hatfield Lecture before the College of Physicians of Philadelphia, are in process of publication. It may suffice to say that the modern operation of sensory root avulsion, whoever may deserve the main credit for evolving the procedure, is an operation practically free from risks and with a mortality lower than that of almost any other so-called ("major") operation in surgery.

In my own series, now comprising 348 cases, there have been only two fatalities, the ninth and thirtieth cases, both of them dating back to the days when efforts were made to remove the ganglion together with the root in their totality. There have been 318 consecutive cases without a fatality. There is no other operation in surgery which can so completely relieve such an incapacitating malady and with such slight risk. There are possibly 5 per cent. of the cases which are not cured, cases in which the diagnosis was incorrect and in which the facial pain, supposedly trigeminal, is really of some other origin.

department was not utilized to its full capacity for many reasons, not the least of which perhaps was the old chauvanistic idea that he who is called a general surgeon must do equally well all things surgical. Nevertheless, the desirability and need of specialization in military medicine more than in any previous war came to be accepted as a principle, and in some divisions of the service where it obviously could prevent wastage of man power, it played an important rôle.

Those of us, however, who had the overseas responsibility for the care of such injuries of the nervous system as would incapacitate soldiers for further service, aware of the fact that these men would be the last of all our wounded to recover, and even then very imperfectly, were disturbed by the lack of coordination of neurologic interests which possibly the scramble during our short period in the conflict made inevitable. Since most of the surgeons delegated to the neurosurgical subdivision had only a meager neurologic training and the neurologists were all occupied in the important field of psychiatry, none of us got as far with our neurologic problems as if we had been organized together.

Cognizant of all this, Drs. Salmon, Schwab, McCarthy and myself, after many conferences, were unanimous in the feeling that some more effective organization should be brought about and that centers should be established where psychiatrist, neurologist, neurosurgeon and neuropathologist could be brought together, and where functional as well as organic cases could be seen and studied and treated conjointly for the benefit not only of the soldier but of neurology itself.

This is all past history which I have gone into more fully on another occasion,[33] but I touch on it again for the reason that out of these conferences there developed the idea of a National Institute of Neurology. The four men whose names I have mentioned agreed to withdraw from the pre-war engagements to take full-time positions in such an institute, provided the necessary funds could be secured for its establishment on a generous national scale. No one could possibly have been better fitted to launch and direct such an institute than Colonel Salmon, whose interests largely lie in the sociological aspects of neurology. It was hoped that under him, as subordinates, a neurologist, a psychiatrist and a neurosurgeon might each have a hospital ward for their special cases, and that the neurological laboratory, which under the direction of Major Weed in Baltimore had done such admirable work during the war, might be taken over intact. It was assumed that during its first few years this institute would be entirely

33. Concerning the Establishment of a National Institute of Neurology, Am. J. Insanity **76**:113 (Oct.) 1919.

at the disposition of the Government and the Army for the care of the neurologic cases which, as I have said, remain the last precipitate of the war injuries—cases which now, alas, are widescattered.

The venture, proving a success as it almost certainly would have done, it was anticipated that with the war work finished it would become a national center, an institute and hospital, for the study of disorders of the nervous system—a central rallying place where psychologist, psychiatrist, neurologist, neurosurgeon and experimental pathologist could work in cooperation—a training ground as well for their successors who for the first time in any country would be given an opportunity, after graduation, for a broad general neurologic training.

This, gentlemen, is by no means an idle dream. The situation two years ago was most favorable for the inauguration of such a movement, a movement whose ultimate objects were to bring intimately together all of those who from one aspect or another are attacking problems relating to the diseases of the mind and the nervous system. There is nothing which is possibly of more vital concern to the nation than a knowledge of the mental disorders to which its citizens are subject. There are few things relating to the health and well-being of the community more neglected. For a single imperfectly endowed clinic for the study of mental disorders probably twenty institutes for the study of cancer, of infectious diseases and so on have been established, whereas the insane forgotten in our asylums and those with nervous and mental disorders who helplessly frequent our clinics and outpatient departments out-number all other patients by far.

This project may seem far removed from neurologic surgery, but I have an instinctive feeling that some day such an institute on a scale as large as the recently founded Institute of Hygiene will come to be established. When that day arrives, the neurosurgeon will of necessity be a participant, and from the contacts therein possible will come to have the proper neurologic training essential to the success of his particular field. He will need a preliminary general surgical training, but he will nevertheless have to be a product of a school of neurology in a broad sense, such as we do not now possess, nor any other country.

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In the preamble to this address regarding specialization in general, my hearers may have been aware, between the lines, that I was reading my own confession into what was written. It is true, for despite a reasonably broad surgical preparation, I confess to have climbed into neurology by the outlying route described. It is for this reason that I thoroughly understand how essential it is for the neurosurgeon of the future, if he is really to do justice to this new specialty, to

have a far better grounding in clinical neurology and psychiatry than I have had, for he must make his own diagnoses and must have an intimate knowledge of neuropathology if he is to know what conditions are amenable to surgical therapeutics.

Many people are eager to enter this field of work. Hardly a month passes without some well established surgeon writing to ask whether his assistant may be given some instruction in "brain surgery" and can we take him. We are glad to do all that is possible. "Yes, he attended lectures in neurology as an undergraduate, and then there are colleagues who will make his neurologic studies and use the ophthalmoscope for him." He comes and spends a short time as an onlooker and returns to his clinic a neurosurgeon.

It will be a bad thing for neurologic surgery when it becomes fashionable. Gynecology has already suffered from this, and orthopedics is in the way to follow. Tendencies in this direction, to my despair, are apparent. Glad as I am to feel that the importance of the subject as a special line of work is becoming recognized, and confident as I feel that the day will come when professors of neurology in our schools will have had a surgical training just as the present-day gynecologist and orthopedist must have, nevertheless the way to bring about this desired end is not through the surgical operating room alone, but by the slow process of the neurologic clinic and the laboratory. Let us hope that some day in a national institute, such as I have described, the all-round training which is essential may be properly acquired by medical graduates desiring to enter this field.

But for its own good, I pray that neurologic surgery may never get so far from the home of general Medicine and its immediate parent, surgery, that there will be any estrangement or any possibility of its being shut out of doors when the time comes for its return.

ABDOMINAL NEURASTHENIA*

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Among the large number of so-called neurasthenics, there is a group in whom symptoms relating to the digestive apparatus largely dominate the clinical picture. This group has been classified by a number of writers as "abdominal neurasthenics" and the digestive troubles have been attributed, very properly in most cases, to the loss of tone in the muscular and chemical activities of the digestive apparatus secondary to the neurasthenia. As a result, treatment of the abdominal disturbances has been largely symptomatic, and investigation has usually stopped short after the examination of one or two test meals and stools have revealed nothing of marked significance.

With the aid of stomachics, sedatives, cathartics, irrigations, and other procedures, the digestive tube has been used merely as a machine for forced feeding in the attempt to regain the general strength and, in conjunction with the various other therapeutic measures, to restore the nervous balance.

A small series of cases from this group has been studied with great interest during the last six years and the findings both from investigation and from the results of therapeutic effort indicate a new line of attack which is successful in selected cases.

For brevity's sake a few characteristic case histories will be summarized and permissible deductions drawn from them.

REPORT OF CASES

CASE 1.—*History.*—Miss Bessie C., 33 years old, was well until 12 years of age. Since that time she had never been robust. She had had various children's diseases. For years she suffered from marked constipation, alternating with cramps and diarrhea. In 1910 she was operated on for "chronic appendicitis." The appendix was not found, but a large lymph gland was removed from the cecal region and was reported to be tuberculous. Since 1913 onward she had had irregular attacks characterized by loss of consciousness, followed by abdominal pain, nausea, vomiting and marked prostration. She became a chronic invalid, spending much of her time in bed. She could assume no regular duties in life, because of headaches, lack of stamina and abdominal disabilities. She was seen by many consultants who labeled her "neurasthenic and hypochondriac." She became progressively worse.

Physical Examination.—In the fall of 1916 she was placed in the care of Dr. Malcolm Goodridge. He found that she was of small size, slender, fairly well nourished and that she had good color. (She had just finished a three months'

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*Read at the Forty-Sixth Annual Meeting of the American Neurological Association, New York, June, 1920.

stay at a sanatorium.) Other findings were hemoglobin, 100 per cent.; red cells, 6,187,000; white cells, 10,000; polymorphonuclears, 70 per cent. Head, mouth, lungs, heart and urine were negative. Stomach, 100 c.c. retention 3 hours after 200 c.c. meal; achlorhydria. Stools were negative. The abdomen was somewhat distended with gas, and showed the scar of the appendix operation. There was a fairly marked tenderness over the right iliac region with gurgling of gas on pressure. There was also tenderness in the right hypochondrium near the ninth cartilage and just to the right of the median line in the epigastrium. The stomach was considerably enlarged.

Roentgenograms revealed a large "fish-hook" stomach with the greater curvature below the brim of the true pelvis; the duodenum fixed high up under the liver with sharp angulation between the first and second portions and with distortion of the cap. The cecum was dilated and descended into the true pelvis. The hepatic flexure was fixed high and angulated near the duodenum.

Consideration of the clinical history and the objective findings, especially the enlarged stomach with retention, the high fixation and distortion of the duodenum, the high fixation and kinking of the hepatic flexure with marked dilation of the cecum and stasis in the ileum, led both Dr. Goodridge and myself to feel that the anatomic distortions caused the abdominal symptoms and that the neurasthenia had resulted from the oft repeated pains and continued toxic absorption.

Treatment and Course.—She was operated on Oct. 20, 1916, under ether anesthesia. A transverse right rectus incision was made 4 cm. above the umbilicus. The findings were enlarged stomach, freely movable, reaching well over into the right flank, then turning backward, upward and inward to the place where the summit of the duodenum was held fast to the proximal third of the gallbladder by a double fold of peritoneum which kinked and compressed it. This double fold passed over the duodenum down to the hepatic flexure, which it also held high and kinked. Neither duodenum nor flexure could be displaced downward. This double fold was divided transversely and the duodenum and hepatic flexure mobilized downward so that kinks and compression were relieved. The gallbladder was normal except for attachment of the double fold. Adhesions between the omentum and the scar of the previous operation were separated. A small retrocecal appendix was found and removed. There were no signs of tuberculous infection in the ileocecal region. A Jackson's membrane of moderate size which kinked and compressed the ascending colon was divided and the colon mobilized. The wound was closed and she was returned to bed in good condition.

Recovery was uneventful and comfortable. She remarked that a "dragging sensation" always present in the epigastrium had disappeared. Healing was by primary union and skin sutures were taken out on the sixth day. She took food freely and with relish after the first few days and without her customary pains and flatulence.

Two months after the operation she reported she had had no abdominal disturbance and had gained much in weight and color.

Sixteen months after operation she reported that she never had any discomfort after food unless she was extremely tired; she was troubled with gas only at rare intervals; she could eat all kinds of food and was moderately constipated. During this interval, for several months continuously, when her father and mother were both ill, she managed the household and helped with the nursing, doing far more in the way of continuous physical, mental and emotional effort than she had ever been able to do in the preceding six years.

At the end of two and three-quarters years she reported that her digestion was absolutely normal and her strength and capacity for steady work "decidedly" increased. She had some headaches and occasional constipation. During the last six months of this period she had felt better than at any time in years.

Case 2.—*History.*—Mr. W. T. J., Jr., 27 years old, was well until he was 26 years old, when he developed a marked nervous breakdown in the fall of 1916. In January, 1917, he had influenza twice, followed by profound neurasthenia. After two months of quiet outdoor life in the South he improved considerably. He then entered the Plattsburg training camp, but after a month was discharged because of "recurrent neurasthenia." He was then carefully examined by Dr. Walter Niles.

For over a year he had been much troubled with belching and flatulence, which was not accompanied by pain. His appetite was good and his bowels moved daily. Often he had a sensation of weight after eating. His chief complaint was dull headache, loss of memory and initiative, profound lassitude, mental depression and attacks of hysterical weeping. He was incapable of carrying on his work as a lawyer.

Physical Examination.—He was a tall, slender, dark skinned, sallow man. Examination of the head, throat and chest was negative. The blood pressure was 144 mm. The abdomen was normal in contour and mobility and was moderately tympanitic everywhere. The sigmoid was slightly tender. Slightly to the inner side of the right anterior superior spine and about 4 cm. below its level was a localized spot of extreme tenderness, associated with muscular spasm. To the right of the median line in the epigastrium was an area of definite but moderate tenderness.

Roentgenograms demonstrated a fish-hook stomach with the antrum well over to the right of the spine. It showed no deformity in outline and peristalsis was vigorous. The stomach was empty in three hours. The first portion of the duodenum was of average size, with smooth edges and no sign of ulcer. It was fixed high. Eight hours after eating there was slight retention in the ileum. Thirty-six hours after eating 90 per cent. of the meal had been discharged. The cecum was deep in the pelvis, from which it could not be dislodged, and it was tender. The urine was clear, acid, specific gravity 1.029, with a faint trace of albumin and no sugar. Microscopic examination was negative. Findings of the stool were negative; gram-positive bacteria, 25 per cent.; gram-negative, 75 per cent.

Treatment and Course.—He was operated on Nov. 27, 1917, under ether anesthesia. A transverse right rectus incision was made about 5 cm. above the umbilicus. The findings were: Stomach and pylorus free from ulcer or inflammation, duodenum fixed high to the proximal 4 cm. of the gallbladder by a double fold of peritoneum which caused definite kinking of the duodenum at the junction of the first and second portions. The gallbladder was normal except for the fold running to the duodenum. The liver was normal. The ascending colon was compressed by a Jackson's membrane. The cecum was nonadherent, dilated and had attached to it an appendix about 8 cm. long, irregular in caliber and with one considerable enlargement (fecal concretion) at about its middle. The remainder of the abdominal contents were normal.

The procedure was: Division of the duodenal membrane, mobilization of the duodenum downward (5 cm.) with whipstitching of the raw edges; division of Jackson's membrane with release of the ascending colon; appendectomy, with inversion of stump; closure of wound by layer sutures.

Recovery was uneventful, and he rapidly regained his health. He joined a naval cadet camp and went through the hard training without the least troube. His various neurasthenic and hysterical symptoms disappeared within a month of his operation and have never recurred.

On Jan. 24, 1920, he reported that he had been back at business since his discharge from the navy, that he was full of energy and initiative all the time, was never tired and felt better than ever before and had gained 30 pounds.

CASE 3.—*History.*—Mrs. T. N., 39 years old, as a child had children's diseases. She had also been subject to attacks of abdominal pain at irregular intervals since childhood, chiefly in the right lower quadrant. These pains were of short duration, but were prolonged by walking. Five years ago these attacks became more severe. The last one occurred in June, 1917. Her periods had always been normal. She had two children, 10 and 8½ years old. Her appetite was fair, food caused no pain, but she had much flatulence, and was only occasionally constipated. She suffered frequently from severe headaches; tired out quickly and completely and was unstable in her nervous system and self control. She had become progressively worse during the last two years.

Physical Examination.—She was a tall, thin, sallow, irritable woman, weighing 110 pounds. Examination of the heart, lungs and urine were negative, as also was bimanual pelvic examination. The abdominal wall was flat, minus subcutaneous fat, and moved normally in respiration. The sigmoid was spastic and moderately tender to pressure. Pressure along the colon upward and to the right caused much gurgling of gas, but no pain until the right ninth costal cartilage was reached, where there was localized tenderness. The cecum was much distended. There was extreme tenderness over an area 2 by 1 cm. about half way from the right anterior superior spine to the umbilicus. As her appendix had to be removed, it seemed unnecessary to subject her to the trouble and expense of a barium series of the gastro-intestinal tract, as complete exploration could be done when the appendix was removed.

The diagnosis was chronic appendicitis; probable Jackson's membrane.

Treatment and Course.—She was operated on Dec. 4, 1917, under ether anesthesia. A transverse incision was made of the right rectus, 2 cm. above the umbilicus. The findings were: The stomach was greatly distended and crowding over into the right flank; there was no ulcer. The duodenum was kinked and held high by a short double fold of peritoneum running from it to the proximal end of the gallbladder and also by firm, thick adhesions running to the undersurface of the right lobe of the liver, 2 cm. to the right of the gallbladder. The liver and gallbladder otherwise were normal. The right kidney was freely movable. The appendix was pathologic, running upward and inward behind the cecum. Jackson's membrane extended from just above the cecum to the hepatic flexure, where there was a thick, short band, kinking and compressing and holding the flexure high. The uterus was normal. The right ovary was quite fibrous and had a firm nodular growth at its hilus. The left ovary was one cyst.

The following procedure was used: Division of membrane and adhesions binding duodenum to gallbladder and liver; mobilization of the duodenum downward 4 cm.; raw edges whipstitched; appendectomy, with inversion of stump; division of Jackson's membrane with mobilization of the colon; double oophorectomy, one ovary being a cyst and the other showing a probable beginning malignancy. The wounds were closed by layer sutures.

Convalescence was uneventful; the wounds healed by primary union and the patient returned home on the nineteenth day. She was given endocrine therapy from the fourth day after operation.

After five months she reported that she was feeling well and was slowly gaining weight. After eighteen months she was maintaining her improvement in color, weight, digestion, strength and capacity for sustained effort. She has recovered her nervous balance.

CASE 4.—*History.*—Miss Jean W., 17 years old, was said to have had typhoid when 3 years old and since that time had been subject to bronchitis. In 1910 she was operated on for hernia and had not been well since, suffering from severe headaches, anorexia, constipation, nervous depression, backaches, cold, clammy hands and feet, insomnia and entire lack of stamina. She was troubled with constant flatulence, by a sense of fulness after eating small amounts of food and by pain two hours after eating. Her periods were regular, profuse and painful, necessitating rest in bed.

She was studied by Dr. F. S. Meara, who reported the following results: Blood: hemoglobin, 81 per cent.; color index, 0.8 per cent.; red blood cells, 4,740,000; white blood cells, 6,900; polymorphonuclears, 45 per cent.; lymphocytes, 46 per cent. Urinalysis: The urine was acid; the specific gravity was 1.018; there was a faint trace of albumin and no casts. The stools were negative; gram-positive, 15 per cent.; gram-negative, 85 per cent. Lungs and heart were negative.

She was tall for her age, thin, and fairly nourished. The abdominal wall was thin and retracted, but moved normally with respiration. The stomach was enlarged down to the umbilicus. The sigmoid was spastic and moderately tender. There was distinct tenderness and resistance just to the left of the median line about 3 cm. above the navel; also at a point 6 cm. within and 2 cm. above the level of the right anterior superior spine. Otherwise the findings of the abdominal examination were negative. Her hands and feet were cold.

Roentgenograms showed: Marked gastroptosis, the greater curvature being below the sacral promontory; six hours' retention of barium; no sign of ulcer; retention in the duodenum with signs of obstruction at the duodenojejunal angle. The appendix visualized early, segmented and retained the barium throughout the period of investigation (forty-eight hours). The colon was slow in emptying, the cecum was club-shaped and showed retention. The ileocolic valve was incompetent.

Treatment and Course.—Operation was advised and accepted on the basis of the obvious disturbance of the appendix and duodenojejunal angle. The operation was performed May 30, 1918, under ether anesthesia. A transverse incision of the right rectus was made just above the umbilicus.

The findings were: The stomach was normal except for enlargement and adhesion between the pyloric antrum and the transverse colon. Pylorus and beginning duodenum were normal, except that they were dilated. The duodenojejunal angle was pulled upward and to the left by a strong peritoneal fold which caused marked angulation and obstruction. There were several enlarged lymph glands among the superior mesenteric vessels near the angle. A broad thick Jackson's membrane enveloped the cecum, ascending and beginning transverse colon, causing compression and kinking. The appendix was 10 cm. long, segmented and nonadherent. There was a calcareous gland in the ileocecal angle. The pelvic organs and kidneys were normal.

The following procedure was used: Plastic release of the duodenojejunal angle which came down 5 cm.; removal of the lymph gland for pathology; release of the colon from Jackson's membrane; appendectomy, with inversion of the stump; removal of the calcareous lymph node. The wound was closed by layer sutures.

Recovery was uneventful except for a stitch abscess in the skin. On the twenty-third day she left the hospital feeling better than for months. The lymph nodes were reported as showing simple chronic inflammation. Five months later her physician reported great improvement in every way. Twenty-four months later she reported marked improvement in appetite and capacity to take general diet. She was occasionally troubled with gas and constipation. Her capacity to do things was greatly increased.

SUMMARY AND CONCLUSION

These four cases, briefly summarized, were selected from a larger series to illustrate varying phases of the problem.

The patient in Case 1 had had a prolonged history of abdominal pain and digestive disturbance, on which the neurasthenic condition had been engrafted and finally became the predominating feature in the minds of many of the consultants. The patient in Case 2, who had had little digestive disturbance beyond flatulence and that without constipation, suddenly developed a neurasthenia, apparently idiopathic, which was greatly increased by influenza. For a year he had had various treatments without result. The patient in Case 3 also had few symptoms relating to the digestive tract, except flatulence and occasional constipation. Her neurasthenia came on gradually during several years, was associated with lack of mental balance and probably with disturbance of the endocrine system. The patient in Case 4 had never been robust and developed a profound neurasthenic condition following a simple herniotomy. In her case the neurasthenic and abdominal symptoms developed simultaneously and were about equally prominent over a period of eight years.

All four of these patients had been under the care of competent internists for from one (Case 2) to eight years, and were given repeated rest cures and other treatment, under which they improved only to slide back on attempting to take up their duties in life. Finally a painstaking examination of the digestive apparatus indicated what proved to be, in these cases, the chief underlying cause of the illness. The nerve exhaustion was apparently secondary to the absorption of toxins from the digestive canal, and it is my belief that the formation of these toxins largely resulted from mechanical interference with the normal motility of the digestive canal.

It is worthy of notice that in each case there was a high obstruction and a low obstruction. The high obstruction resulted from kinking and compression of the duodenum by a Harris band from gallbladder to duodenum in Cases 1, 2 and 3, and from kinking of the duodenojejunal angle in Case 4. The low obstruction in each case resulted from constriction and angulation of the ascending colon and hepatic flexure by a Jackson's membrane. In each case the appendix was definitely pathologic.

In this type of case, examination of the gastric contents seldom gives any information of value except as to the presence or absence of retention. Likewise, examination of the stools seldom gives information of value.

The diagnosis depends on the manual examination of the abdomen, showing tenderness over the appendix, ascending colon, hepatic flexure, gallbladder and pylorus or duodenojejunal angle, or showing distention of the cecum, or distention and ptosis of the stomach or dilatation of the duodenum. These may occur in varying combinations.

These findings are verified, amplified or modified by the roentgen series. A series to be of any value must be made by a man skilled in determining the times, attitudes and numbers of plates to be taken, and also in interpreting the plates and the results of fluoroscopy, which is one of the essential elements of a proper roentgen examination.

When an accurate diagnosis is made, a properly planned surgical procedure usually gives a prompt and permanent relief to the digestive disturbances and rapid recovery from the associated neurasthenia.

The obvious deduction from the facts presented is that a complete examination should be made of the digestive tract of every neurasthenic. In a certain proportion of cases surgery would offer a short cut to recovery.

A CASE OF CEREBRAL POROSIS WITH A HISTOPATHOLOGIC REPORT *

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In cerebral porosis the brain tissues contain a large number of cavities or cysts combined with minute holes generally described as "état criblé." Unlike other types of cavities, such as porencephaly, Marie's [1] lacunae, or Grasset's [2] progressive lacunar cerebrosclerosis, both cerebral porosis and "état criblé" are so far devoid not only of clinical but also of pathologic significance, being generally considered as artefacts, as accidental postmortem findings, in short, as cadaveric changes. One of these conditions, the "état criblé," has been discussed by me [3] at some length elsewhere, while the histologic study of the present case shows that cerebral porosis also possesses certain essential pathologic features which are due to intravitam changes and cannot be looked on as mere artefacts.

REPORT OF A CASE

A woman, 24 years old, born in Finland, entered Dr. Arthur Byfield's medical service of Cook County Hospital, March 26, 1920, in a semistuporous condition. Thirteen days previously she had been seized suddenly with severe abdominal pain accompanied by nausea and vomiting. This condition persisted for twelve days and greatly weakened the patient. She was able to be up and around, but was too weak to do her housework. On March 25, that is, on the twelfth day of her sickness, while taking a Turkish bath, she became "feverish" and so ill that she had to be removed to the Cook County Hospital. According to her family physician, she had not menstruated for six weeks.

Examination.—The patient was apathetic, but could be easily aroused and answered questions intelligently. The skin was dark bronze, the conjunctivae and sclera were yellowish brown, the nares were covered with dried blood, the neck was slightly rigid and the abdomen was tender throughout and rigid.

The tongue was heavily coated; marked pyorrhea was present. The respiration was labored, but there were no findings in the lungs or heart.

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* From the pathology laboratories of Cook County and Psychopathic Hospitals, Chicago.

1. Marie, Pierre: Des foyers lacunaires de désintégration et de differents autres états cavitaires du cerveau, Rev. de méd. **21**:281, 1901.

2. Grasset, I.: La cérébro-sclérose lacunaire progressive d'origine arterielle, Semaine méd. **24**:329, 1904.

3. Hassin, G. B., and Bloch, Leon: Trichinosis Complicated by Encephalitis, Med. Record **91**:537 (March 31) 1917.

The reflexes (abdominal and knee) were absent; the Babinski and Gordon reflexes were present on the right and absent on the left; the Oppenheim reflex was negative on both sides.

The urine was dark, contained bile, albumin and blood (the patient was menstruating); there were no casts, no signs of phenol or mercuric chlorid.

The spinal fluid was slightly tinted and under somewhat increased pressure, with a positive Nonne test and ten lymphocytes per cubic millimeter. Cultures from the spinal fluid made on broth and blood-agar plates remained sterile after forty-eight hours' incubation. Acid fast stains failed to reveal the presence of tubercle bacilli; neither were other micro-organisms found.

The blood examination showed 50 per cent. hemoglobin; 3,700,000 erythrocytes; 37,000 white cells; coagulation time, twenty-two minutes. The blood Wassermann test was unsuccessful as the blood was hemolyzed.

Temperature on admission was 105.2 F. (rectum), pulse 120, respiration 24. The next day the forenoon temperature was 100; the abdominal tenderness was marked throughout and a friction rub appeared over the pulmonic apexes. The stools showed presence of blood, and the gynecologic examination revealed a soft cervix discharging blood and mucus and admitting two fingers. The blood from the uterus appeared in twenty-four hour cultures sterile. The patient died the next day (March 27, 1920).

Clinical Diagnosis.—The diagnosis was hemolytic jaundice. Necropsy was performed fifteen hours after death by Dr. Fred Stangl, the cadaver having been kept in the refrigerating room. The body was well nourished, the skin intensely yellow and showed a distinct crepitation. The uterus, mediastinal fatty tissue and pericardial sac were "ballooned" with gas; the left pleural cavity and the pericardial sac contained bloody fluid (about 600 c.c. in the former); gas was also present in the left cardiac ventricle, myocardium, vena cava, hepatic veins, spleen, liver, kidney and lungs, which were edematous and showed distinct crepitation.

Brain.—Calvarium could easily be removed; the leptomeninges were opaque and contained bubbles of gas and free fluid which was blood stained; the convolutions were wide and flattened; the sulci narrowed. The brain weighed 1,260 gm., was soft and did not crepitate.

The bacteriologic examination revealed *Bacillus aerogenes capsulatus* isolated in pure culture from the heart's blood, pericardial fluid, cerebrospinal fluid, peritoneal fluid and spleen, all taken from the body at necropsy.

Anatomic Diagnosis.—The conditions found were gas bacillus bacteremia; menstruating uterus, gas bacillus infection of the uterus, hematogenous disseminated gas bacillus infection of the heart, lungs, liver, kidneys, spleen, brain, subcutaneous and muscular tissues ("foamy organs"), serosanguineous bilateral hydrothorax, hydropericardium and hydroperitoneum.

Microscopic Examination.—The brain had been fixed in toto in 10 per cent. formaldehyd solution and cut six days after it was hardened. Frontal sections revealed an enormous amount of cavities (Fig. 1), especially in the region of the large basal ganglions and the cerebral white substance (centrum semiovale, internal and external capsules, corpus callosum), partly in the cerebellum, pons and medulla, while the cortex was macroscopically normal throughout. The cavities of various dimensions and irregularly scattered were divided from each other by septums of various thickness, some as thin as paper, giving the brain the appearance of Swiss cheese or of a crumb of bread. The microscopic exam-

ination of celloidin sections also showed much smaller cavities, especially in the gray matter of the brain, causing a sieve-like appearance of the section, "état criblé" (Figure 2).

Aside from the large and small cavities, the microscope revealed a large number of vessels packed with thrombi, which exclusively consisted of gas bacilli. The remaining substance of the brain, scattered among the larger cavities, was in some instances normal, in some broken up and granular, while the pia appeared hyperplastic and the subarachnoid space distended and infiltrated with various pathologic elements.

The foregoing findings—cavities, "état criblé," gaseous bacilli, thrombosis, meningeal and parenchymatous changes—will be taken up in some detail.

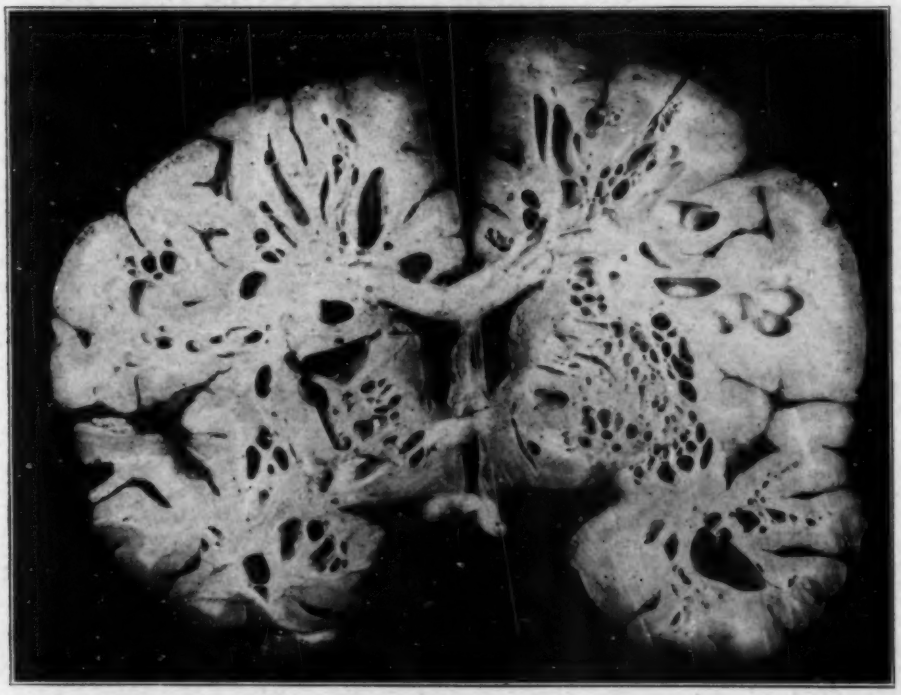

Fig. 1.—Frontal section of the brain through the optic thalamus and lenticular nucleus. The gray matter of the cortex is free from cavities which are exclusively confined to the white substance.

CAVITIES AND "ÉTAT CRIBLÉ"

The majority of the cavities were empty, few contained fragments of broken up nerve tissue (destroyed ganglion cells, fat, globules, débris of nerve fibers and glia tissue), and some distinctly showed the presence of a so-called membrane. Photomicrograph (Fig. 3) shows one type of such a membrane in the form of a broad folded homogeneous band of connective tissue, somewhat irregular in shape and separated from the adjacent parenchyma by a free empty zone. The collagen fibers of the membrane contained oblong sausage-shaped

nuclei, rich in chromatin, which were especially well pronounced in loose "membranes," which were represented by thin strings of connective tissue fibers (Fig. 3). "Strings" were unusually common in the cavities, evidently being parts of the adventitial wall of blood vessels detached from the latter during sectioning and left in the cavities.

In the photomicrograph (Fig. 4) a longitudinally cut vessel can be discerned surrounded by a zone of friable tissue which in its turn is surrounded by a condensed stripe of parenchyma forming as it

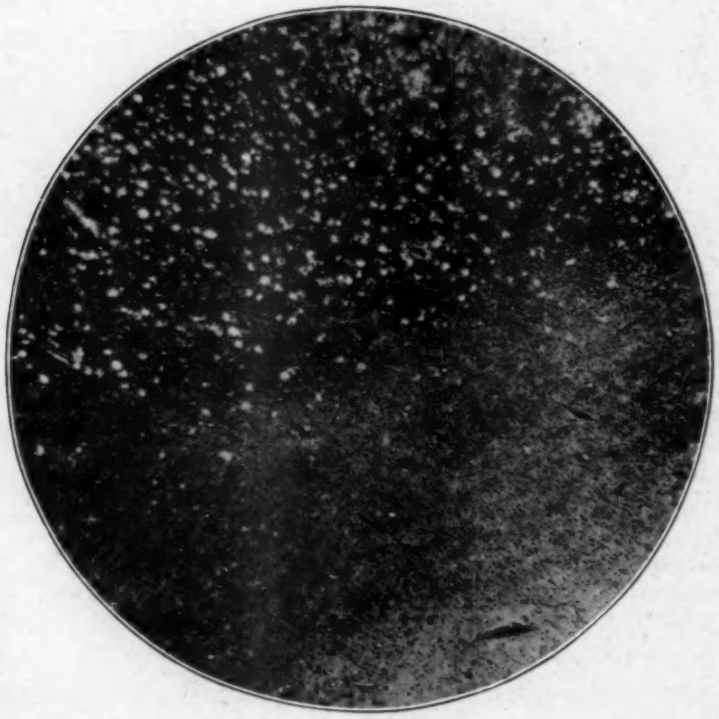

Fig. 2.—The upper half shows état criblé; the lower, with the help of a hand lens, appears granular (the numerous small dots); the larger streaks are vessels filled with gas bacilli. Bielschowsky stain; celloidin section 15 microns thick; × 50.

were a line of demarcation. Such a demarcation line frequently surrounds a cavity resembling a distinct membrane.

Other cavities were lined by a dense row of microbes which also may look like a distinct membrane. Large as the cavities might be, they did not invade the gray matter of the cortex from which they were separated by a thickened rim of glia tissue. Only in the gray matter of the large basal ganglions were cavities occasionally found, sometimes attaining quite large dimentions.

As a rule, the cavities in the gray matter were very small, in the form of minute holes the size of a pinhead, giving the section a fine, sieve-like appearance described by Durand Fardel as "état criblé" (Fig. 2). The latter was particularly noticeable in the basal ganglions and less so in the cortex where the "holes" surrounded the ganglion cell and capillaries. There were no membranes in these holes which frequently were represented merely by rarefied glia tissue appearing as a network of pale round minute islands. Both cavities and état criblé were especially in evidence around the vessels which seemed

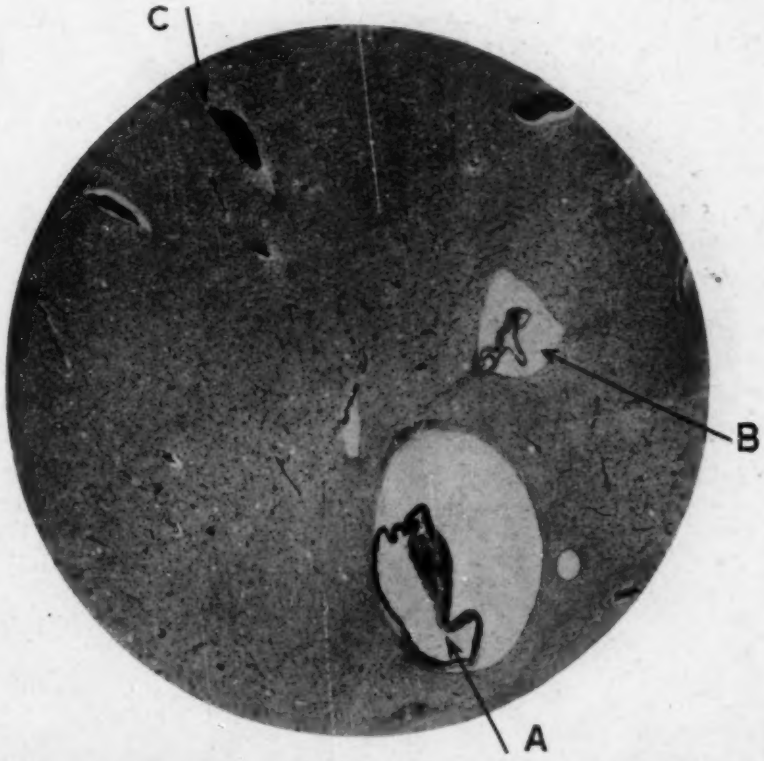

Fig. 3.—Cavities, some of which show remnants of vessels in the form of strings, especially the upper one—*B*. At *A* the vessel surrounds a remnant of brain tissue; at *C* the vessel is surrounded by rarefied glia tissue (this can be seen with a hand lens). Mallory-Jacob stain; × 32.

to play a prominent part in their formation. They showed marked and interesting changes throughout the brain.

VESSELS

In some regions, like the cortex, the vessels formed a rich network of capillaries distended and filled with blood (Fig. 5); they showed a well-defined adventitia and well stained endothelial cells,

but no dilatation or infiltration of the Virchow-Robin spaces. In some areas of the cerebral cortex and especially in the cerebellum, the midbrain and the pons, there were a great number of smaller or larger veins densely packed with gas bacilli (Figs. 6 and 7), which usually totally obliterated the vascular lumen or preferably covered the vessel walls. The latter sometimes were so densely lined with swarms of bacilli that their condition was hard to ascertain. The adventitia generally appeared more or less thickened but without any pathologic or infiltrating elements and without dilatation of its spaces. Such

Fig. 4.—Substantia nigra. The longitudinally cut blood vessel in the lower half of the picture is partly surrounded by a zone of rarefied, vacuolated glia tissue which shows distinct demarcation lines especially above the blood vessels. Mallory-Jacob stain; × 32.

thrombosed vessels were surrounded by a greatly changed parenchyma which (Fig. 6) was homogeneous, pale, without any nerve fibers or glia nuclei. The few glia cells found in the vicinity were pale, shrunken and usually poor in chromatin. In some instances the parenchyma was distinctly areolar, loosely connected with the blood vessels around which a network of vacuoles was formed (Figs. 3 and 4). The vacuoles, by gradual coalescing, form larger vacuoles or cavities,

or the loose reticular tissue surrounding a vessel may totally break down, leaving a vacant space around the vessel; the latter may even be pushed aside or fall out, leaving a cavity instead. The cavity thus originates around a changed blood vessel (thrombosed) which is the cause of some parenchymatous changes.

PARENCHYMA CHANGES

These were by no means universal. Thus the general architecture of the cortex was intact, the usual array of Brodmann's layers pre-

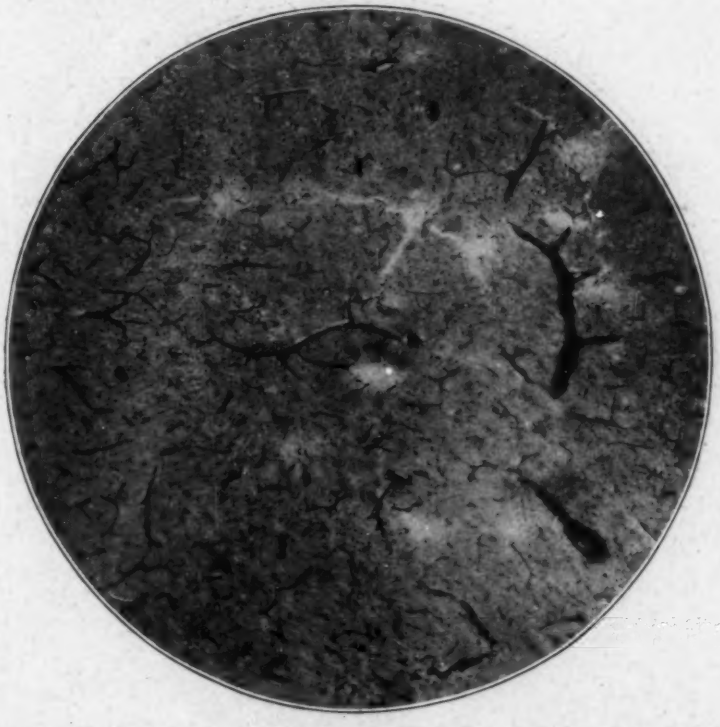

Fig. 5.—Excessive vascularization of the cortex (motor area). Alzheimer-Mann stain; × 50.

served, many ganglion cells showing no abnormalities whatever, but exhibiting marked changes. For instance, in the motor area some ganglions showed a greatly enlarged nucleus surrounded by a free zone, the cell processes being unusually deeply stained and therefore traceable for a great distance; in some the apical dendrones were coarse or broken up, the cell bodies swollen with the nucleus misplaced, somewhat resembling the condition of axonal reaction; other cells were totally homogeneous and invaded by glia cells (neurophagia). Some again exhibited marked chromatolysis. In the caudate nucleus,

substantia nigra and lenticular nucleus, the ganglion cells were mostly pale, their nuclei poor in stainable substance and covered by a twisted or distorted membrane; in the subcortical white substance filled with cavities, the Bielschowsky silver stain (of celloidin sections) revealed in some instances a mass of granular amorphous tissue, so well shown on microphotograph 2. The nerve fibers were coarse, granular, or broken up in globules of various sizes without any reactive phenomena on the part of the glia, which was represented by some dark round nuclei. Herxheimer scarlet red stain revealed no lipoid substance in

Fig. 6.—The cortical and subcortical regions of a temporal lobe, showing an abundance of blood vessels packed with gas bacilli. The colorless areas surrounding the blood vessels are well marked (use a hand lens). Toluidin blue stain; × 50.

the broken up areas of the brain tissue, but showed an abundance of the same in the cavities, capillaries and some in the ganglion cells. The capillaries densely covering the cortex were almost without exception packed with fat which in but few instances could be located within the endothelial cells of their intima lining. In the larger vessels, especially those found within the cavities, fat was abundantly represented in the shape of large globules within the adventitial cells while the ganglions contained traces of fat and the glia cells no fat at all.

PIA-ARACHNOID CHANGES

Considerably more pronounced were the reactive phenomena in the pia-arachnoid and the subarachnoid space. The pia-arachnoid was hyperplastic (Fig. 8), with greatly distended meshes, usually packed with various cellular elements (Fig. 9): erythrocytes, lymphocytes, plasma cells, polyblasts, macrophages, gitter cells, amorphous granules of hemosyderin and a great number of mesothelial cells (Fig. 10). The deeper layers of pia were densely covered with gas bacilli. In some areas the erythrocytes predominated, forming hemorrhagic foci; in other places the lymphocytes prevailed, mixed with plasma cells, polyblasts and macrophages, while mesothelial cells were abundant all

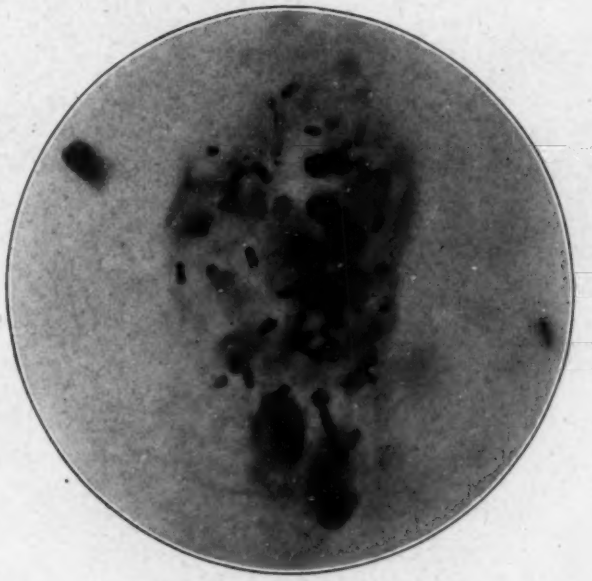

Fig. 7.—Gas bacilli within a vessel. Toluidin blue stain; × 1200.

over, frequently forming colonies or, as it were, pure cultures. The fibroblasts sometimes appeared unusually well developed as large oval or round bodies, with few chromatin granules and pale processes. Typical fibroblasts with long and well developed processes were not uncommon. The gas bacilli were either freely scattered among the foregoing elements or were found in large masses within the pial veins, especially around the cerebellum. Even the smallest prolongations of the pia showed in the latter an abundance of blood vessels packed with bacteria. As in the cerebral pia, the cerebellar meningeal vessels were not infiltrated, and did not exhibit enlarged perivascular spaces which were free from any pathologic elements. The pia sub-

arachnoid around the pons and lower medulla showed the same wealth of reactive phenomena in the form of the noted cellular elements. In no other pathologic condition could I encounter such a variety and abundance of phagocytic elements, especially of the so-called mesothelial cells—the detached cover cells of the arachnoid membrane and its trabeculae. It is highly possible that some of the phagocytic cells (macrophages, for instance) were transformed mesothelial cells, such a transformation having been so well studied and represented by Essick.[4]

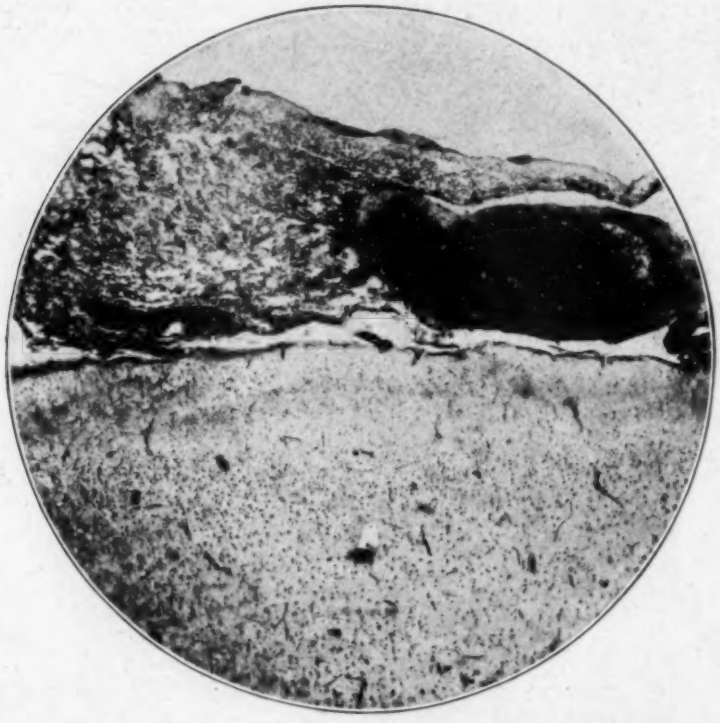

Fig. 8.—The pia arachnoid membrane shows marked hyperplasia, infiltration and a large thrombosed vein; the cortex an abundance of capillaries. Alzheimer-Mann stain; × 321.

DISCUSSION

The most striking pathologic features in this case are the cavities, the bacillar venous thrombosis and the subarachnoid changes. The most striking clinical phenomena are the bronze skin and mental dulness. Both clinical and pathologic findings are most probably a mani-

4. Essick, C.: Formation of Macrophages by the Cells Lining the Subarachnoid Cavity in Response to the Stimulus of Particulate Matter, Publication 272 of the Carnegie Institution of Washington, pp. 377 and 388.

festation of the gas bacillus infection, of which the cavities are the most outstanding pathologic features. Repeatedly described and discussed, especially in the older literature, the cavities have been looked on as distended so-called perivascular spaces of His, supposed to be situated between the adventitia of a blood vessel and the brain tissue. The distention is due, according to Ripping,[5] Schlesinger,[6] Pick,[7] Neudoerfer,[8] and others to congestion of the blood vessels associated with increased "lymph" production in the spaces of His. The "lymph" becomes blocked, producing "lateral protrusion" of these spaces and ultimately leading to a cavity formation. Neudoerfer even assumed that the adventitia becomes coalescent with the adjacent brain tissue, thus still more interfering with the discharge of the lymph from the spaces of His. It is needless to dwell further on such views, for the presence of His spaces has not been altogether proved, in fact, is not recognized by the majority of neuropathologists. It would, therefore, be hazardous to build theories on such a weak basis. Moreover, the flow of the so-called brain lymph is not confined to His but to Virchow-Robin's spaces situated between the media and adventitia. These spaces were entirely normal in this case, as well as in another similar case studied by Dinkler.[9]

Another widely accepted teaching that the cavities are the result of fixation procedures of the brain before it is sectioned, or the result of delayed sectioning (Savage and White)[10] received serious consideration. The fact that the cavities may be found before any fixation has been used and even when the brain is immediately cut after its removal, speaks against such a theory.

The third theory is that of Pierre Marie—cavity formation is probably a product of putrefaction caused by the invasion of gas bacilli. Such a view was also shared by Hartman,[11] who so far has been the only author who could confirm Marie's assumption by demon-

5. Ripping: Ueber die cystoide Degeneration der Hirnrinde bei paralytischen Geisteskrannen, Allgm. Ztschr. f. Psychiat. **30**:309, 1874; **33**:424, 1876.

6. Schlesinger: Ueber cystenförmige Erweiterungen der Hirnrinde, Arch. f. Psychiat. u. Nervenh. **10**:16, 1880.

7. Pick, A.: Ueber cystöse Degeneration des Gehirns, Arch. f. Psychiat. **21**:910, 1890.

8. Neudoerfer, R.: Dementia paralytica, état criblé, cyst. Degeneration, Virchow's Arch. **146**:369, 1896.

9. Dinkler, M.: Ein Beitrag zur Lehre von den feineren Gehirnveränderungen nach Schädeltraumen, Arch. f. Psychiat. **39**:445, 1905.

10. Savage, G. H., and White, H.: On the Causes of Holes in the Brain, Together with two Cases of Universal Cystic Degeneration, Trans. Pathol. Soc., London, **24**:1, 1883.

11. Hartman, F.: Eine eigenartige post-mortale Cystenbildung im centralen Nervensystem, Wiener klin. Wchnschr., 1900, p. 963.

strating the gas bacilli invasion. However, he, too, considered the porosis as a cadaveric phenomenon, though he thought that the gas bacilli invaded the body intravitam and proliferated after death. The study of this case, the second in literature in which the presence of gas bacilli could be demonstrated, shows that in cerebral porosis the cavities are not the sole pathologic manifestation, that they are combined with a widespread bacillar thrombosis of the pial and cerebral veins as well as with a breaking up of the glia and brain tissue proper and formation of fat-like substances and marked pia-arachnoid

Fig. 9.—Marked infiltration of the pia arachnoid, of the pia prolongations; practically normal appearance of the cortex. Toluidin blue stain; × 50.

changes. All these changes are evidently premortal, not artefacts; nor are they due to lymph stasis in the spaces of His, but most probably to gas bacillus infection. It may be assumed that the latter mechanically brings about the disintegration of the brain substances, especially around the blood vessels, their severence from the loosened and broken up glia tissue ultimately leading to a cavity formation. The fixation of the brain also may contribute to the porosis, but secondarily by causing excessive shrinking and collapse of the blood vessels as well as of the brain tissues themselves. The latter must

be pathologically altered before they can undergo any shrinking; they must first be rendered unstable by some morbid process, in the present case by the gaseous bacilli and excessive accumulation of gas, as the cavities seem to form only in places where the nerve and glia tissues appear friable, and where they are thus easily broken down, either from the direct action of the bacilli or from their mechanical distention and separation from the vessels by the formed gas.

Such a pathogenesis of cerebral porosis seems to conform with the histopathologic findings in this case and seems to justify an assumption that cerebral porosis is a distinct pathologic entity with histopathologic features not to be found in any other infection of

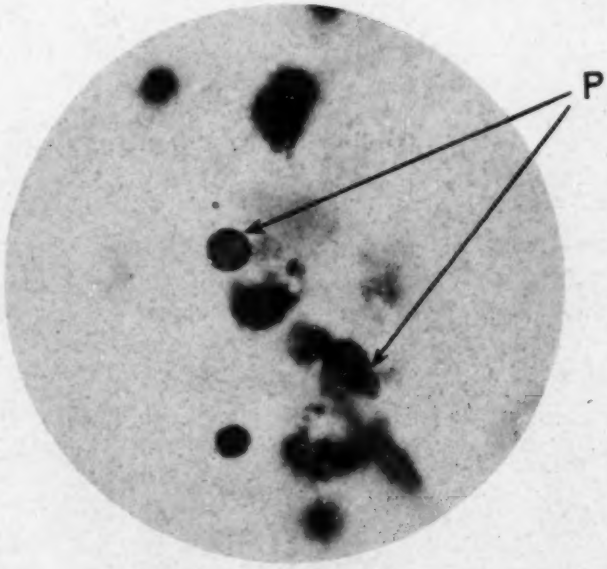

Fig. 10.—Some of the cellular elements of the subarachnoid space reproduced in Fig. 9. Two plasma cells (*P*) and two lymphocytes (dark round bodies) are distinctly seen. Toluidin blue stain; × 1200.

the central nervous system. In other words, the brain seems to react in a specific manner against a gas bacillus invasion, just as it specifically reacts against any other infection or intoxication, for instance, paralytic dementia, epidemic (lethargic) encephalitis, lead encephalitis, and other conditions.

It is obvious that further studies of cerebral porosis cases are exceedingly important and desirable as the existing contributions to this problem, almost all belonging to the older literature, are devoid of bacteriologic and proper histopathologic records, and are not therefore of great value. The previous reports pertain to the most varied con-

ditions. I will but mention the cases of L. Clarke [12] (1870) and Ripping (1874 and 1876), both of general paralysis, the case of Byron Bramwell [13] (1886)—tuberculosis, of Neudoerfer (1896)—a combination of paralytic dementia and tuberculosis, and of Dinkler (1905)—trauma of the skull complicated by dementia. In none of these cases is mention made of the presence of gas bacilli.

31 North State Street.

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12. Clarke, L.: A Case of General Paralysis with Examination of the Brain, Medulla Oblongata and Spinal Cord, J. Mental Sc. **15**:499, 1870.

13. Bramwell, Byron: A Remarkable Case of Disseminated Softening of the Brain with the Formation of Numerous Small Cysts, Edinburgh M. J. **32**:425, 1886.

A SUPPORT IN FACIAL NERVE PARALYSIS

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Facial palsy is rather common and occasionally results in the disability and deformity of complete, permanent paralysis; a less frequent consequence is contracture—but still a deformity. At times these disfigurements may be avoided, yet the condition is too often left to the hazard of "spontaneous cure."

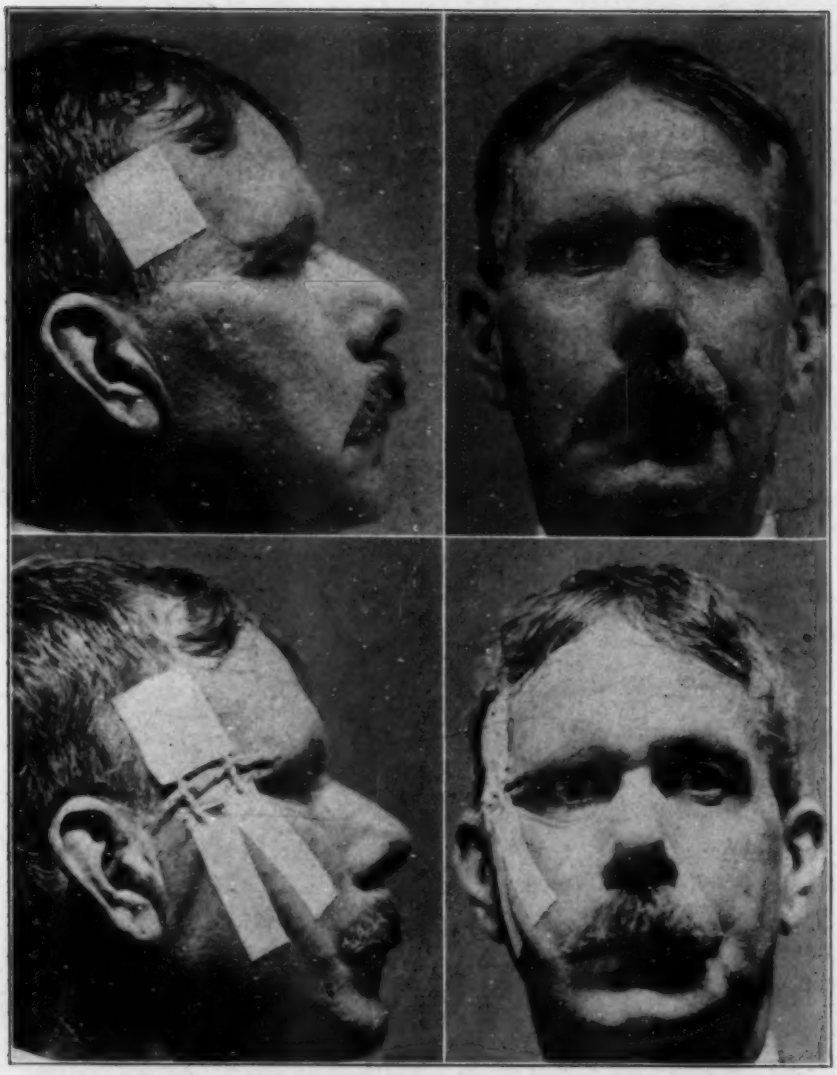
Many feel that in the acute stage of palsy support should be given, and I am positively of this opinion, but the task has been difficult of accomplishment. Several methods have been devised and that recently reported by Jaeger[1] before the New York Neurological Society is said to yield gratifying results. This orthopedist places over the head a net arranged as a cap, to which are attached ribbons and these are fastened at their lower ends to strips of plaster adherent to the sagging cheek. Others have elevated the cheek by means of a hook which engages the angle of the mouth, but this arrangement often causes irritation of the mucous membrane; furthermore, the parts are not brought in proper position.

A device I am using is simple and efficient. Curiously enough, while the scalp at the sides of the head may be moved freely upward and laterally, it may not—fortunately for our purpose—to any extent be pulled downward, and this allows a secure point of attachment toward which the cheek may be drawn.

My method is, first, to cut a strip of plaster 1½ inches wide and about 1¾ inches long, which is firmly pressed well up on the temporal region; this attaches itself securely to the scalp and hair and will remain for a considerable time. Next, a similar strip is cut about 2 inches in length, one end of which is folded on the adhesive side for about a quarter of an inch as reinforcement and into this two perforations are made. Then a strip is cut about 3 inches in length, reinforced as before and correspondingly perforated; the other end is divided longitudinally about 2¼ inches. Finally, two cords are inserted vertically into the perforations and the device is completed.

Apply the support by firmly pressing the smaller strip over the permanent one already adherent to the temporal region, adjust the divided one to the sagging cheek, approximate the free ends and tie the cords securely. The intervening space affords freedom from pressure to the wrinkles necessarily caused by elevation of the cheek.

1. Jaeger: Arch. Neurol. & Psychiat. **1**:374 (March) 1919.



Author's device for support in facial paralysis

This support is adjustable, comfortable, inexpensive, will last for days and, if soiled, may be easily removed and renewed. By no means does the method supplant other forms of treatment, such as physiologic stimulation of muscle action through ideation, internal medication, massage, electricity and diathermia. Briefly, the advantages of such a device are: amelioration of mechanical difficulties such as arise in talking and mastication, hastening of recovery through removal of strain caused by the considerable weight of paralyzed and sometimes edematous tissues on toneless muscles, particularly on the diseased nerve, and also of the blocking of the intermittent tug from muscle action on the sound side. It should prevent some of the disabilities and deformities which one occasionally encounters—hence always fears—in severe facial palsy.

TINEL'S SIGN, FORMICATION OR DISTAL TINGLING ON PERCUSSION AND DEEP PRESSURE SENSATION

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Tinel's sign, formication or distal tingling on percussion (D. P. T.), is, as described by Tinel, a creeping sensation in the cutaneous distribution of an injured nerve when compression or percussion is lightly applied along its course peripheral to the injury. The sign indicates that the axis cylinders are in process of regeneration. The following conclusions relative to the importance of this sign were reached after 2,500 personal examinations in over 500 cases of peripheral nerve injury, operative and nonoperative. The patients had been injured at least three months prior to their entrance to General Hospital No. 6. Examinations were made monthly as a matter of routine.

TECHNIC

With all muscles of the part relaxed, gentle finger percussion is performed, beginning as near the distal distribution as possible and proceeding proximally.

INDICATIONS

1. Progressive formication is not an infallible sign of regeneration in a peripheral nerve. It may be present along the entire course of a nerve, when the greater part of the motor fasciculi are found at operation to be bound up in scar tissue.

ILLUSTRATIVE CASE.—S. G. received a double perforating wound in the left arm and forearm Sept. 29, 1918, which resulted in a supracondylar fracture of the humerus, which healed in sixty days. Wrist drop with loss of dorsiflexion of the proximal phalanges and cotton wool and pin prick anesthesia over the dorsum of the wrist developed immediately. Dorsiflexion of the wrist returned about Dec. 25, 1918. Feb. 1, 1919, the triceps, supinator longus, extensor carpi ulnaris and radialis longus contracted normally, but there was no contraction of the other extensor muscles. Formication was present along the course of the radial nerve below the wound in the forearm, but not between the wounds. On exploration of the lower wound, Feb. 18, 1919, the radial nerve was found to be intact, while two thirds of the fibers of the posterior interosseus were divided and the remaining few caught in scar tissue. In this instance tingling accompanying regeneration of the sensory branch would naturally indicate an accompanying regeneration in the motor half of the musculospiral nerve.

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*In charge of Neurosurgery at General Hospital No. 6, Fort McPherson, Georgia, from Jan. 1, 1919, to Jan. 15, 1920.

Following suture of the musculospiral nerve, formication generally advances steadily. We have instances, however, of regeneration of this nerve without formication. Examination of patients with musculospiral lesions shows that the extent of sensory loss bears no relation to the presence or absence of tingling. In one case formication was absent during the entire period of regeneration though the area of anesthesia was typical of musculospiral division.

2. Tingling is not indicative of normal regeneration unless referred to the peripheral distribution of the nerve involved. There is what might be called false formication.

(*a*) A few sensory fasciculi may extend along the trunk for a short distance below the lesion and tingling will be referred to the cutaneous area supplied by these fasciculi.

(*b*) A nerve in close relationship may register a jar. The operator may contuse other nerves in the immediate vicinity and following healing of the wound percussion may cause tingling in an area other than that primarily involved. In several cases of fused neuroma of the ulnar and median nerves, tingling was referred to the distribution of both nerves. In one case of resuture and separation of the lines of anastomosis by a muscular partition, this false type of formication prevailed throughout the period of regeneration. Tapping over the course of the ulnar nerve caused tingling in the distribution of the ulnar and median nerves while tapping over the median caused tingling in the little finger only.

(*c*) A nerve lying close to a bone may give rise to confusing responses. Tapping on an uninjured peroneal or ulnar nerve opposite the head of the fibula or the olecranon will produce tingling not unlike that which accompanies a nerve lesion.

(*d*) Impaired circulation due to interruption of the main artery to the extremity interferes with the proper interpretation of formication. This is especially true in the lower extremity because of passive congestion and edema.

(*e*) Ascending neuritis precludes the possibility of accurate knowledge of regeneration of the nerve involved. The excruciating pain along the entire trunk and peripheral branches, and the extreme nerve and muscle tenderness make examination difficult. In the 550 cases examined there was only one such case.

(*f*) The patient may attempt to deceive. It is essential that the patient's cooperation be obtained. Frequent examinations and careful records will generally detect the malingerer.

3. In a case of regenerating sciatic nerve, percussion over the posterior tibial may cause tingling on the dorsum of the foot. In

such a case the tibial communicating branch of the posterior tibial is responsible, uniting as it does with the fibular communicating branch of the peroneal to form the external saphenous. Unless the examiner is careful this tingling may be referred to the musculocutaneous distribution. The patient should be requested to point to the area.

4. Familiarity with nerve distribution is essential. Where nerves lie in close relationship as do the musculocutaneous, anterior tibial and external saphenous, tapping over the peroneal or musculocutaneous may give rise to tingling on the dorsum of the foot, although the anterior tibial is completely blocked. In testing formication in the leg the anterior tibial should be tested first by gently tapping close to the tibial crest, causing formication over the crest of the dorsum of the foot to the base of the great toe.

5. Peripheral nerve injuries are often associated with cicatrices: Between 40 and 50 per cent. of all patients operated on had scars at the site of the nerve injury which in themselves required surgical attention. Of the patients that came to operation, at least 70 per cent. had no tingling in the course of the injured nerve except when percussion was applied at the site of the scar. The quality of the tingling is of importance in interpreting the underlying pathology. If a patient has only slight or moderate tingling over the entire course of an injured nerve and there is marked formication on percussion over an adherent scar or if the progress of formication has been slow, the condition is sufficiently serious to warrant an exploratory operation, the probability being that most of the fasciculi are divided or compressed in scar tissue. In one instance in a reoperative median nerve case in which formication had advanced at the rate of $\frac{1}{400}$ inch daily, only four fasciculi of a total of approximately thirty were found intact.

6. Formication is of the greatest value in determining the degree of progress after an end to end suture. For several weeks after operation correct interpretation is impossible because tapping near the operative site causes false formication. We believe that formication in a sutured sciatic nerve is of little value until ninety days after operation. In 90 per cent. of the cases percussion within this period over the nerve below the point of suture causes formication either in the distribution of the external and internal plantar or of the external saphenous nerve.[1] The rate of descent of formication varies with (*a*) the nerve, (*b*) the site of suture, (*c*) the degree of tension under

1. The tingling in the external saphenous distribution is the only evidence of regeneration in the external cord until the axis cylinder processes reach the head of the fibula.

which the nerve is placed after suture, (*d*) the conditions under which the anastomosis is done, (*e*), the fact whether or not rerooting is done, and (*f*) postoperative treatment.

(*a*) *The Nerve.*—The subjoined table shows the rate of descent of formication in various peripheral nerves following end to end suture:

RATE OF FORMICATION IN PERIPHERAL NERVES

Leg	Fraction of Inch Per Day	Arm	Fraction of Inch Per Day
Sciatic	1/13	Median (arm)	1/18
Peroneal	1/18	Median (forearm)	1/20
Posterior tibial	1/15	Ulnar (arm)	1/17
Musculocutaneous	1/24	Ulnar (forearm)	1/26
Anterior tibial	1/29	Ulnar rerooted	1/38
		Musculospiral	1/18
		Posterior interosseous	1/34

(*b*) *Site of Suture.*—Formication advanced more rapidly after suture in the arm than in the forearm. It advanced more rapidly in a sutured sciatic, less rapidly in the peroneal and still less rapidly in the anterior tibial.

(*c*) *Degree of Tension.*—In some instances in order to overcome a large gap in the nerve, considerable tension was placed on the line of suture; in such cases, progress of formication has been somewhat slower.

(*d*) *Conditions under which Anastomosis Was Done.*—In a large percentage of cases the nerve injury was associated with other conditions, such as bone lesion, ununited fracture, or latent osteomyelitis with sequestrums. In a small percentage a bone operation was done at the time of nerve suture (sequestrectomy or bone graft) and the nerve placed in a muscular tunnel. Formication with one exception advanced normally. This case was an end to end suture of the musculospiral nerve, 5 cm. above the external condyle, with an arthroclysis for fibrosis of the elbow joint, followed by a mild infection involving the periosteum. Reoperation was necessary, and the nerve was found to be compressed and edematous for a distance of 7 cm. Postoperative infections due to the release of an adherent nerve from the bone have not diminished the rate of progress of formication. These cases for the most part were musculospiral sutures. When suture of the musculospiral was accompanied by operation for associated osteomyelitis, the line of suture being protected by a muscular flap, the rate of advance of formication was 1/21 inch.

(*e*) *Rerooting.*—The delay in the advance of formication in ulnar suture in the forearm is in part due to interference with the branches

which go to the flexor carpi ulnaris and flexor profundis digitorum. Formication following a rerooting advances more rapidly when these branches have not been stripped back. When a rerooting has been done to overcome a defect in the arm and these fibers have not been interfered with, formication advances to the periphery much more rapidly ($\frac{1}{17}$ inch in a day).

(*f*) *Postoperative Treatment.*—The effect of electricity and massage on the different forms of sensation following suture of a sciatic nerve may be noted in Case 5. So far as we know, only two cases of suture done at U. S. Army General Hospital No. 6 have separated, both musculospiral cases. This was due in the first case to an infection following the insertion of an intramedullary bone peg in an ununited supracondylar fracture of the right humerus, the line of suture being directly opposite the center of the defect. In the other case it was due to carelessness of the ward surgeon, who completely extended the patient's forearm two weeks after operation. The nerve did not separate at the site of the suture, but 1 cm. above. There was no advance in formication in seven months after operation; reoperation revealed the condition. In another patient transferred to this hospital eight months after suture of the external cord of the sciatic nerve in the lower third of the thigh, there was no advance in formication and reoperation disclosed separation and displacement of the distal end to the inner side of the inner cord adhering to it for a distance of 5 cm.

DEEP PRESSURE SENSATION

The following tests were begun with one idea in view, namely, to aid in determining early the presence of regeneration following the suture of a divided nerve. The sciatic nerve was selected because of the large area supplied.

TECHNIC

The foot was kept in warm water for about ten minutes before the reading and the patient placed in a comfortable position. The examiner sat at the end of the table and supported the foot in a flexed position. This is important; otherwise movements of the joint or pulling of the skin may be felt above the area of anesthesia and confuse the patient. Ingham's algesimeter for testing deep pressure may be used, but an ordinary lead pencil with a good rubber tip serves just as well, and since the same person always makes the test, it is not difficult to keep the amount of pressure fairly constant. After repeated trials I find that I use about 1 kg. of weight. Weekly examinations were made. Cooperation of the patient is absolutely necessary; he must differentiate pressure from movement or jarring.

We have considered pressure pain as evidence of return of deep sensibility. We have tried testing with and without blindfolds and our results have been practically the same. Over 500 cases of peripheral nerve injury have been examined during the past year, making in all about 3,500 charts.

Tests following suture of divided sciatics, with one exception, showed that the lighter forms of sensory loss, that is, anesthesia to absorbent cotton and light pin prick, do not shrink week by week

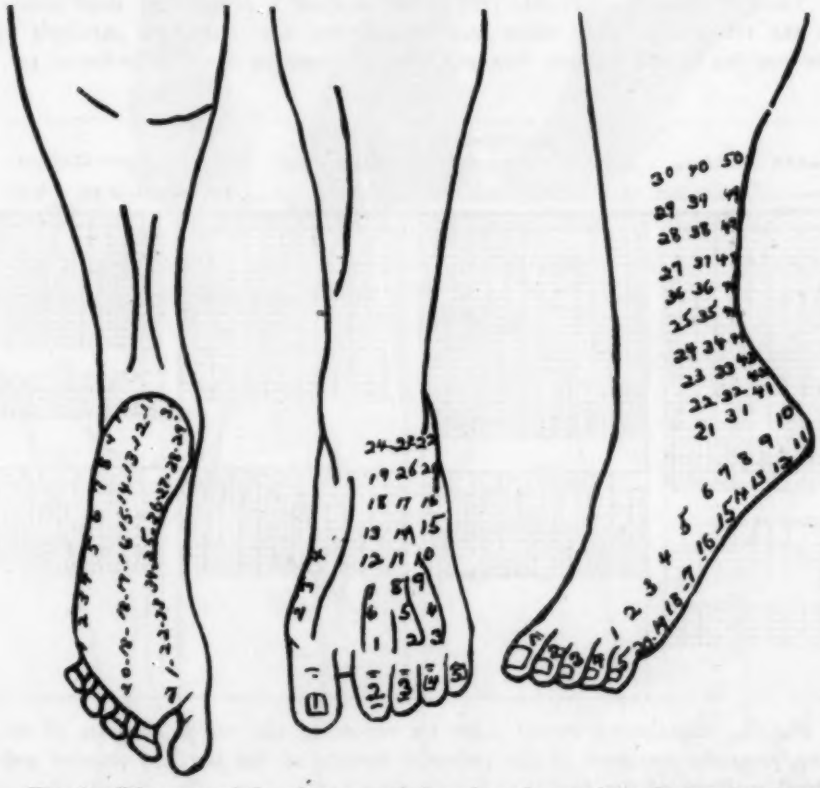

Fig. 1.—Diagram of the plantar and dorsal surfaces of the foot and peroneal surface of the leg, indicating, by numbers, the points for testing the deep pressure sensation.

or month by month but invariably remain the same even after there is a return of motion. In the area of deep pressure loss, however, there is a definite shrinking which may be noticed as early as four weeks following suture. In some cases, within a period of twenty or thirty days following suture, there may be hyperesthesia of the leg and foot, a development which may be misleading.

For recording our results, we have charted the peroneal surface of the leg and plantar and dorsal surfaces of the foot, which are

numbered for convenience (Fig. 1). Records of the tests can be kept either on the drawings or, preferably, on the deep pressure algesimeter record sheet; a cross opposite the number corresponding to the one on the drawing indicates that deep sensibility is present at that point (Fig. 2). The reverse side of the algesimeter sheet may be used for records of the operative diagnosis, operation and pathologic report.

REPORT OF CASES

Case 1 (Fig. 2).—Oct. 14, 1918, J. A. received a perforating shell wound of the lower left thigh; there was no fracture, but immediate paralysis of the muscles of the leg and foot and loss of sensation over the peroneal sur-

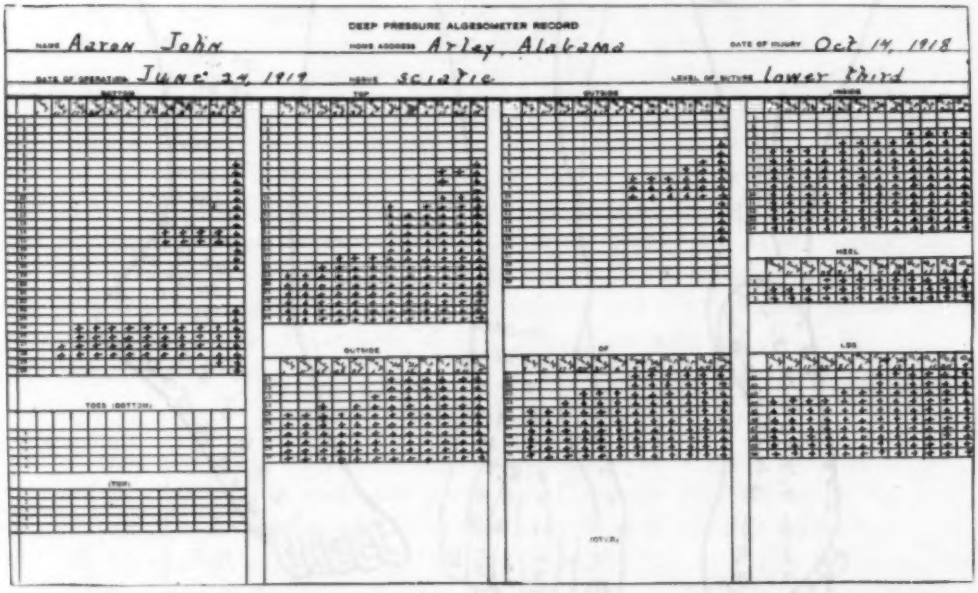

Fig. 2.—Algesimeter record sheet for recording the results of tests of the deep pressure sensation of the peroneal surface of the leg and plantar and dorsal surfaces of the foot.

face of the leg and dorsal and plantar surfaces of the foot; there was no paresthesia or causalgia. The wound was healed June 1, 1919.

Examination.—Examination revealed marked atrophy of the leg muscles, a slightly edematous and mottled foot, no fibrosis, dry and scaly skin, thickened and transversely ridged nails, paralysis of the leg and foot muscles; formication extended from the middle of the scar to the plantar surface of the foot and toes. Figure 3 shows the first test, made one week after operation; Figure 4 shows the last reading, five months later. This case shows the typical shrinking of the area of deep pressure loss. The resection and suture of the nerve were perfect; the healing was normal and treatment was begun early.

Fig. 3 (Case 1).—Showing the area of deep sensory loss one week after resection and suture of the sciatic nerve.

Fig. 4 (Case 1).—Showing the area of deep sensory loss five months after resection and suture of the sciatic nerve.

Fig. 5 (Case 2).—Showing the area of deep sensory loss ten months after resection and suture of the sciatic nerve.

Fig. 6 (Case 3).—Showing the area of deep sensory loss seven months after operation.

CASE 2 (Fig. 5).—On July 4, 1918, J. G. was wounded by a machine-gun bullet which perforated both thighs, in the middle third; there was no fracture, but immediate paralysis of both legs and feet. The wound was healed Nov. 4, 1918.

Examination.—This revealed complete block of both sciatic nerves.

Course and Treatment.—The patient was operated on, neurolysis and fiber dissociation for a distance of 10 cm. being performed on the right side, and on the left, resection of fusiform neuroma with end to end suture. There was complete recovery of paralyzed muscles of the right lower extremity at the end of eight months. Figure 5 shows the area of deep sensory loss in the left foot ten months after operation; there was no improvement over the read-

Fig. 7 (Case 4).—Showing the area of deep sensory loss after neurolysis and fiber dissociation of the sciatic nerve.

ings taken five months earlier, indicating some interference with the regeneration. The area of anesthesia to cotton wool and pin prick remained the same.

CASE 3 (Fig. 6).—W. L. received, Oct. 4, 1918, a perforating wound of the upper third of the left thigh, midposterior aspect; there was no fracture, and the wound had healed October 18. He had immediate paralysis of the muscles of the leg and foot, loss of sensation over the peroneal surface of the leg and the plantar and dorsal surfaces of the foot, and suffered intense causalgia of the foot.

Course and Treatment.—Operation was performed Feb. 15, 1919. This consisted of end to end suture, 3 cm. below the tuberosity of the ischium. The

chart shows delayed return of deep sensation, the patient having had no massage or electricity for seven months after operation. The circulation of the limb was poor, the skin had a lifeless mottled appearance and the muscles were markedly atrophied. There was improvement in trophic disturbances and deep sensation one month after physiotherapy had been instituted.

Case 4 (Fig. 7).—A. A. M. received, July 22, 1918, a perforating wound of the upper left thigh, with complete block of the sciatic nerve; there was no fracture and the wound had healed, Aug. 9, 1918. Causalgia of the plantar surface of the foot was present for thirty days.

Course and Treatment.—At the operation, Nov. 18, 1918, neurolysis and fiber dissociation were performed; the nerve was not sutured. Following operation, the patient showed no improvement in deep sensation, as shown in Figure 7.[1] At the second operation, Nov. 21, 1919, electroconductive tests showed only fibers to the ham strings intact. The remaining four-fifths of the nerve was divided; a neuroma, 4 by 3 by 1 cm., was found on the proximal end, and the distal end was fibrous and adherent to fibers supplying the hamstrings. End to end suture was done, isolating uninjured branches, and the electroconductive tests following suture showed these branches to be intact. In this case, operation was delayed solely because of apparent descent in formication; later we diagnosed this as a false type, tingling being referred mainly to the internal saphenous distribution.

Figures 8, 9 and 10 show records of deep pressure loss six months after suture of the sciatic nerve, the division having occurred at the upper, middle and lower thirds, respectively. These were taken at random and are quite typical of cases six months after operation. Comparison of these charts shows that the area of anesthesia varies with the level of the lesion, the higher the division, the greater the area.

Case 5 (Fig. 8).—T. B. received, Oct. 8, 1918, a perforating wound of the upper third of the right thigh with complete block of the sciatic nerve. There was no fracture; plantar causalgia persisted for two months. The wound was healed, Jan. 8, 1919.

Examination.—There was marked atrophy of the muscles of the leg; the foot was moderately swollen and mottled, the skin dry and scaly; there was no fibrosis; the nails were curved and thickened; no contraction of the muscles of the leg or foot was made out. Formication extended from the middle of the scar to the plantar surface of the foot.

Course and Treatment.—At operation, March 18, 1919, resection of a neuroma and end to end suture of the divided sciatic nerve of the upper third of the thigh were performed; the branches to the hamstrings were intact.

Case 6 (Fig. 9).—L. P. received, Oct. 23, 1918, a penetrating wound of the middle third of the left thigh, posterior aspect; there was no fracture but complete block of the sciatic nerve. The wound had healed, March 15, 1919.

Examination.—There was marked atrophy of the muscles of the leg; the foot was slightly swollen, not mottled; the nails were normal, there was no fibrosis; there was paralysis of the muscles of the leg and foot. Formication was present from the scar to the plantar surface of the foot and toes.

Course and Treatment.—At operation, resection of the neuroma, and end to end suture of the sciatic nerve of the middle thigh were performed.

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1. No tests were made as early as this operation. The comparison refers to typical sutures at the same level.

Fig. 8 (Case 5).—Showing the area of deep sensory loss six months after suture of the upper third of the sciatic nerve.

Fig. 9 (Case 6).—Showing the area of deep sensory loss six months after suture of the middle third of the sciatic nerve.

Fig. 10 (Case 1).—Showing the area of deep sensory loss six months after suture of the lower third of the sciatic nerve.

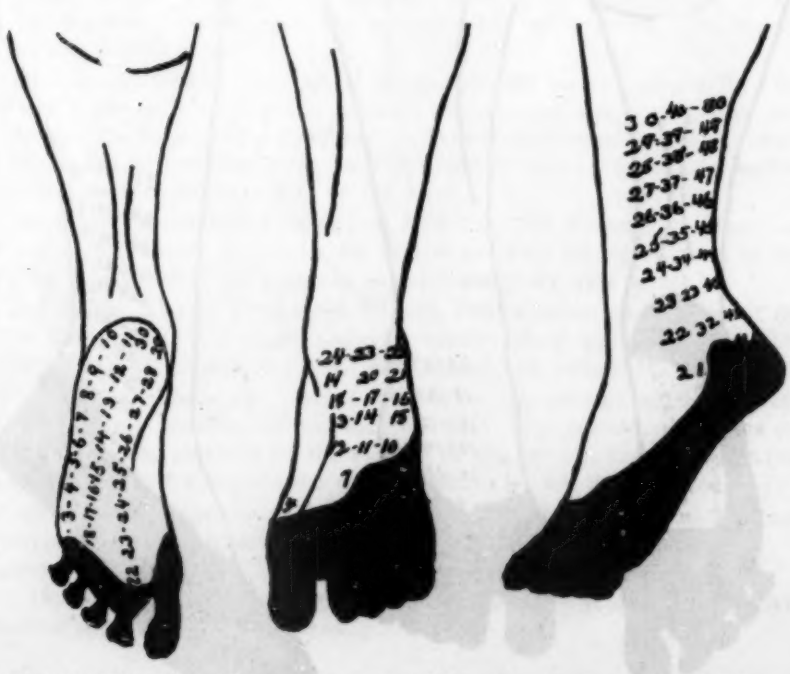

Fig. 11 (Case 7).—Showing the area of deep sensory loss after division and suture of the external popliteal nerve.

CASE 7 (Fig. 11).—J. S. received, July 26, 1918, a perforating wound of the lower third of the left thigh; there was no fracture. The wound had healed, Oct. 15, 1918. Causalgia of the dorsum of the foot began two days after injury, and lasted for sixty days. Following injury the patient had paralysis of all muscles of the leg and foot except the gastrocnemius; there was loss of sensation over the peroneal surface of the leg, and the plantar and dorsal surfaces of the foot.

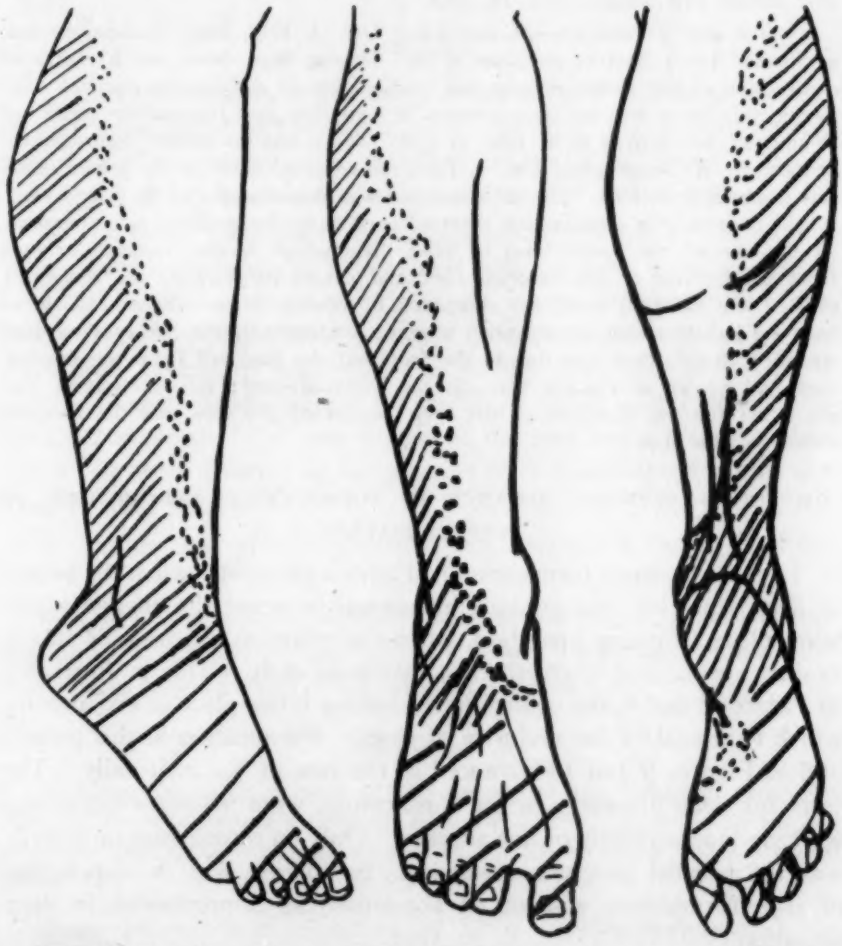

Fig. 12 (Case 8).—Showing light sensory loss with presence of deep pressure sensation in a case of crossing of fasciculi of the internal to the external cord of the sciatic nerve.

Course and Treatment.—At operation, Jan. 29, 1919, end to end suture of the external popliteal nerve and neurolysis of the internal popliteal were performed. Examination, Sept. 11, 1919, showed paralysis of all muscles of the leg and foot except the gastrocnemius. Formication extended over the lower third of the posterior tibial to the external saphenous distribution, and over the peroneal, 15 cm. below the head of the fibula, to the plantar surface

of the foot. At reoperation, Sept. 19, 1919, it was found that the external cord had separated at the line of suture, the distal end being displaced to the inner side of the inner cord. End to end suture was done. Figure 11 shows typically the area of deep pressure loss in division of the external popliteal nerve.

CASE 8 (Fig. 12).—H. T. received, July 18, 1918, a perforating wound of the middle third of the right thigh; there was no fracture, but complete block of the sciatic nerve. Causalgia over the entire foot lasted for two months. The wound had healed, Nov. 18, 1918.

Course and Treatment.—At operation, Dec. 3, 1918, fiber dissociation was performed for a distance of about 8 cm. During May, there was a return of contraction of the gastrocnemius and during July of the tibialis posticus; following this there was an improvement in sensation and formication continued to advance, but proved to be false in type. There was no further improvement in motion. At reoperation, Dec. 1, 1919, the external cord of the sciatic nerve was completely divided. The proximal end was neuromatous (2 by 1 by 1 cm.). It was necessary to separate the external cord from the popliteal space upward. At the site of the lower limit of fiber dissociation several fasciculi crossed from the internal to the external cord and passed downward; the remaining part of the external cord was composed of fibrous tissue. Figure 12 shows only the lighter forms of sensation absent. Undoubtedly the presence of deep sensation in this case was due to the fact that the fasciculi from the internal cord had grown downward through the external cord; this divergence also accounted for the paralysis of the long flexors of the toes and the intrinsic muscles of the foot.

COMPARISON BETWEEN ADVANCE IN FORMICATION AND RETURN OF DEEP SENSATION

In every instance formication had advanced rapidly when the return of deep sensation was normal; by normal is meant the change which takes place following operation, when the resection has been adequate, healing normal and electrotherapy instituted early. This is illustrated in Figures 3 and 4, the change noted having taken place in six months, which is typical of the majority of cases. Formication in this patient and in Figures 9 and 10 advanced at the rate of $\frac{1}{10}$ inch daily. The tests for deep pressure, as for formication, were made by examiners working independently of one another. Only on comparison of records was the parallel progress noted, i. e., in no case was there progress of true formication without an accompanying improvement in deep sensation.

In Case 2 formication had advanced at the rate of $\frac{1}{40}$ inch a day. This is probably due to incomplete resection or partial avulsion of the nerve following operation.[2]

2. Patient J. G., Figure 6, was operated on by the author Jan. 6, 1920. The nerve was divided with the exception of two fasciculi which were nonconductive electrically at the site of the previous suture 10 cm. above the popliteal space. Both ends of the nerve were neuromatous; proximal neuroma 4 x 2 cm., distal 2 x 1.5 cm.; gap between neuromas 10 cm.

In Case 3 there has been no formication since operation, and although the patient received little or no physiotherapy, I am inclined to believe that there is a pathologic condition present to account for lack of improvement.

In Case 4 formication was of the false type, being referred to the internal and external saphenous distribution.

SUMMARY

1. The return of deep sensation is the earliest and most accurate sign of regeneration of the sciatic nerve, the area of anesthesia shrinking in a definite manner and in a definite period of time. This we have not found to be true of the lighter forms of sensation.

2. The term "overlapping" is a misnomer; there is no such thing. When there is shrinking of the area of deep pressure anesthesia, there is without question regeneration of the nerve supplying this area, unless fasciculi which normally supply another area have been diverted from their course by contusion and partial laceration of the nerve trunk. Case 8 illustrates the latter; fibers which under normal circumstances supplied the long flexors of the toes and intrinsic muscles of the foot were diverted by hersage and were responsible for improvement in deep sensation.

3. The psychic effect of repeated examinations is decidedly favorable.

4. There is a definite relation between the return of deep sensation and the advance of formication. When the former returns normally there is an advance in the latter of $\frac{1}{10}$ inch daily.[3]

COMMENT

[With the courteous consent of the authors of the foregoing paper, the Editorial Board requested a comment from Dr. Lewis J. Pollock who has had extensive experience with war wounds of peripheral nerves. His comment follows.]

Deep sensibility is subserved by fibers running mainly with the motor nerves. In a mixed nerve some of the fibers accompany the sensory fibers to the skin. This has been the accepted view for a number of years. Anastomoses between motor nerves is common. Therefore the employment of loss of deep sensibility as a criterion of nerve injury or regeneration is unprofitable except in such a portion

3. The operations on J. A., J. G., W. L., T. B. and L. P. were performed by Lieut.-Col. W. W. Babcock. Pathologic examinations were made by Lieut. Charles H. Manlove. Reoperations were performed by the author.

of an extremity as is supplied solely by one motor nerve. This condition exists in the leg. But it must be remembered that the internal saphenous nerve may be responsible for some of the pain experienced as the result of excessive pressure on areas adjacent to the skin supply of this nerve and within the borders of the sensory supply of the sciatic nerve.

Overlap of peripheral nerves has been recognized for many years. From the results of both division and irritation of peripheral nerves, it has been shown by Head "that as far as protopathic sensibility is concerned they overlap to an enormous extent." This observation has been confirmed by all subsequent work on skin sensation. The residual sensibility of any nerve is greater in area than the accepted anatomic sensory distribution of that nerve.

In the second paragraph of their summary the authors state: "The term 'overlapping' is a misnomer. When there is shrinking of the area of deep pressure anesthesia, there is without question regeneration of the nerve supplying this area." Inasmuch as this communication deals with deep sensation, it is understood that the foregoing conclusion refers only to this type of sensation. That other investigators recognized the existence of overlapping to deep sensibility may be seen from the insistence of Head and his co-workers that in the examination of cutaneous sensibility, only such methods are acceptable as eliminate the possibility of stimulation of deep sensibility by pressure. Unless this precaution is taken sensation is found to be present in areas anesthetic to tactile stimulation.

If, by this conclusion, the authors mean that after overlapping to deep sensibility had already been established following section of a peripheral nerve, any further shrinking in the area of deep pressure anesthesia indicated regeneration, I would agree with them, with certain limitations.

Unfortunately, there does not appear any illustration of the condition of deep sensibility prior to operation and in only one case, Case 1 (Fig. 4), is there an illustration of the extent of loss of deep sensibility soon after operation, in this instance one week. Here the recorded loss to deep sensibility is far less than the accepted anatomic sensory distribution of the sciatic nerve. If, as in the cases observed by me, the loss of deep sensibility occupies an area much smaller than the recognized sensory supply of a severed nerve, overlapping must occur.

To come to a conclusive decision relative to the overlapping of deep sensibility, it would be necessary to study the loss of deep sensibility when several adjacent nerves are injured, the effect of section

of adjacent nerves subsequent to the original injury, and the effect of resection and suture on existing sensibility to deep pressure. In other words, some proof must be adduced to show that there is no overlapping of fibers for deep sensibility. The authors do not include such studies in this communication, and consequently this particular conclusion does not seem to be supported by facts.

LEWIS J. POLLOCK.

NERVOUS SIGNS AND SYMPTOMS AS RELATED TO CERTAIN CAUSATIONS OF CONDUCT DISORDER*

WILLIAM HEALY, M.D.
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In no branch of scientific therapy does one need to establish a clearer conception of etiology than in the treatment of disordered or antisocial conduct. The rewards of discovery of causes are here often astonishingly direct.

While developing case studies in one interesting portion of this rich field, which is being more and more opened to medicopsychologists, we frequently discover nervous signs and symptoms significantly correlated with etiologic facts of great moment for interpretation of the case. In stating that such interlocking phenomena are frequently found, we must frankly admit that they are not always present in instances of apparently like causation, and that their discovery does not indicate the same relationships or the same etiology. The lack of standard correlations is, after all, just such as we recognize in the symptomatology of many functional disorders.

It may be best to direct our discussion from the standpoint of some specific type of conduct. From detailed case records we might consider various sorts of misbehavior in which disturbed nervous reactions offered evidence of the etiology. We could take examples of violent temper, sometimes with assaults on property or person, cruelties or definite sadism, various sorts of extreme meannesses, exhibitionism, fetich collecting, deliberate moral contamination of others, to say nothing of other forms of sex misconduct, persistent school truancy, running away from home, desertion, miserliness, malicious mistreatment of property, setting fires. Many of these are quite evidently based on disordered emotions or on the distorted play of instinct, or otherwise rather obviously connote the possibility of accompanying nervous or mental disturbance.

For the best example of misconduct that would seem to be quite unrelated to nervous phenomena of any kind, except possibly those concomitant with fear and shame, we may take stealing; sometimes cases of the usual type of thieving, but in other instances abnormally motivated stealing, thieving not engaged in for the easily understandable purposes of gain or possession. Cases of plainly abnormal stealing are sometimes brought directly to the specialist in nervous and

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*Read at the Forty-Sixth Annual Meeting of the American Neurological Association, New York, June, 1920.

mental disease on account of the unusual character of the conduct motivation, friends naturally thinking of the possibility of some pathologic condition of the nervous system. From our extensive material we can offer sufficient illustrations of nervous reactions related to this single form of misconduct to serve adequately the purposes of our present text.

SUBJECTIVE PHENOMENA; REPORT OF CASES

Beginning with subjective phenomena we find in our records numerous instances of headaches, "queer feelings" in the head, feelings of excitement and even dizziness, cases in which these symptoms have been significant clews of etiologic factors.

CASE 1.—Take the case of a girl now 15 years old, of somewhat limited mentality and good physique, whom we have had under observation for almost two years, who, up to the time we first saw her had repeatedly stolen in petty ways from homes and sometimes from other places. She herself doubted whether a single month had gone by since she was 5 years old that she had not stolen. She had taken small sums of money and all sorts of trinkets, in spite of corporal punishment and many other efforts at disciplinary treatment by her own respectable family and other people with whom she was placed. She purloined many things of no particular value which she could not use in any way, secreting objects, being generous with money taken, and once unraveling part of a sweater that was being knitted by a member of the family and hiding the yarn. During analysis we found that she derived great excitement from her stealing episodes and a definite sensation of dizziness. Sometimes she wanted to take something, anything, and if she did dizziness and excitement followed, and a little later perhaps a feeling of remorse.

Of course such symptoms indicated some disturbance in her mental life and the revelations of her mental content made the fact particularly clear in this case because the girl herself so plainly worked out for us the links in the chain of associations, going back to early experiences. These involved disturbing sex experiences, first acquaintance with sex words and ideas, together with first knowledge of stealing. Recurrent experiences led to ideation and imagery almost obsessive, which persisted for years. We have her own account of the curious mental mechanisms involved. For example, at 13 years of age, returning for a visit to her home town after a long absence, she engaged in an orgy of stealing foolish things. This was all just after seeing again one of the participants in the original sex-stealing situation, a boy whose name, of course, she had forgotten, but could recall after a time with us. "I took the things only after I saw him." At this time she hid the articles stolen and repeatedly went to look at them, each time experiencing the peculiar feeling which she describes as excitement and dizziness. This is one of the cases in which the analysis of the situation resulted in immediate and continued cessation of the stealing, with no recurrence of the nervous symptoms.

CASE 2.—An active-minded, unusually coherent boy of 9 years, given to such excessive stealing that it was practically a daily affair, reiterated to us at several interviews his marked feelings of nervous upset on occasions when certain ideas recurred to him. After recognizing his nervous reactions during mental testing we found nothing but possibly his moderate coffee drinking to account for them. Placed in a good suburban home he continued to steal with such

frequency that two months later we were asked to see him again and made a much more thorough inquiry. We received finally a specific account of feelings of great nervousness at times concomitant with certain definite mental content. Through this we were led to a first real understanding of his conduct. It was thoughts of a boy, now dead, who had taught him at the same time sex affairs and stealing. "When I feel like taking things I feel nervous and kind of dizzy, and when I think of those niggers and those girls I think of upsetting the whole world. I get excited. I feel funny all over. I feel like turning the whole house upside down on its chimneys." Exploring these experiences and mental associations seems to have started a new career for this boy in spite of the fact that he earlier remarked, "Now I have got started I never can stop. I have two bad habits and one of them is stealing." During several months now he has not stolen, the first break in a delinquent career that had already lasted a long time. It was not his placing out, it was not merely a new environment that turned the trick; as a matter of fact, he stole daily when placed out after first seen by us and when no prolonged or careful analysis was undertaken. The ordinary physical and mental examination threw no light on causation and accomplished nothing therapeutically.

Case 3.—A boy, 8 years old, of good mental ability, positive and nonsuggestible, who had already been complained of in court by his parents for stealing and repeated running away from home, on study by us was found to be quiet, serious and decidedly reticent. We had to see him over and over to acquire any fair understanding of his background, although we early found that he had times when his "head hurt." It was most significant in this case that, reticent and resistant though this boy was, he voluntarily came again and again to see us. It gradually developed that he had "funny feelings" in his head, "cross and mean" feelings which were directly connected with his thoughts about what bad boys do to each other and about a word, "It begins with f," which a boy had spelled out to him the year before. "He learned me how to spell it. He wrote it on the wall. He swears; he takes money from his mother. He told me about stealing."

Case 4.—Another boy, 9 years old, we saw because he was complained of for serious delinquencies, truancy, unmanageableness at home, as well as stealing. He was a boy of good mental ability and fair physical development with some pathologic conditions, namely, slight otitis media and carious teeth. He complained of headaches. We advised, of course, treatment at the hands of specialists and, because of home and neighborhood circumstances, we advocated his being placed in another home. Here for some months he did well, improving much in his behavior except in regard to stealing, and in physical condition except for headaches. We saw him once more and again found in this case that our previous examination, while including the ordinary inquiries, had not reached far enough into either the possible causation of his headaches or stealing. He now seemed most anxious to fathom his difficulties, and his own statements were most illuminating. He feels "rotten and queer" at times, he tells us, and those times are when what he heard about bad things comes into his mind. It is bad words which make his head ache and they make him dizzy, too. He tries hard to get rid of them. "It makes me think of getting into places and taking things." Just before leaving us he said, "When they come in my mind, I try to cross them out, like this (gesturing an X) and sometimes they stick to me and sometimes they don't."

Case 5.—From the cases in which headaches have been reported we may also cite the instance of a boy of 13 years, good in mental ability and normal in

physical development, who demonstrated nervous tendencies by his tense, frowning expression and jerking, incoordinate movements. At home and to us he complained of severe headaches; they were in the back of his head; they came on at night; the boy stated that he used to get out of bed and cry with the pain. His mother put cotton in his ears for it. Worry about words brought on the headaches—bad words in bad stories. The things that had bothered him most in his life had been the bad things he had heard about girls and about stealing and these headaches. He would like a chance to stay in a quiet place, he said.

This has been one of our most unsuccessful cases. Placed with good people, his temperament and the death of both parents seemed to stand in the way of his overcoming his delinquent tendencies. Further stealing led to his commitment to an institution. Before this and several months after we saw him first he reported that his headaches had ceased.

Case 6.—In our Chicago series there was a boy of 8 years, who was considered a desperate problem because he stole. The mother had long known of certain headaches; he complained to her frequently at night about pain in the back of his head and queer feelings there. Pointing to the occipital region he had long ago told her that a word hurt him there. Of course she paid no attention to such a strange remark and had merely told him not to think about it any more; she thought he ought to have some medicine for his headaches. Coming from an open-faced, frank, pleasant, bright-eyed little boy who, in spite of excessive stealing, was reported to be a consistent truth teller, his story to us proved most striking. He went into some detail about his headaches. "It goes right to here in my head and goes all around here and gets me dizzy." "I try to go to sleep and it hurts me. I sleep a little and it starts up again. It hurts me awfully in my head; only at night." We asked him what he thought made him dizzy and headachy. "It's what the kids told me. I roll all around in bed and mamma can't stop me. I think about what they told me, about that stuff, and sometimes it goes right up to my eyes." Other extracts from his statements may be used to give the gist of the situation. "I don't know that word now, I can't remember it. I told my mother it hurt me in my head." "That N. boy talks bad. He says go ahead and steal, steal." He did not want to say those words, he told us with a sigh, because his mother had told him not to say bad words. "It hurts me awfully in my head." Six months later the boy was still in the old environment, was seeing the other boys, was occasionally stealing and somewhat indulging in the masturbation which had begun earlier. However, he said, "Nothing hurts me in my head any more, I'm glad it don't." We advised placing him in some other private home in order that he might have the reeducational opportunity that he needed. This was done and half a year later a marvellous change was reported as having already continued for several months; there had been no stealing whatever and his other bad habits had been discontinued.

The sign or symptom of something abnormal is often phrased as "nervousness" by the relative giving the history or by the young person who is the subject of investigation as a conduct problem. Tenseness of manner or feeling, shown often by nervous habits, particularly biting the nails, irritability in social reactions, undue restlessness or tendency to hyperactivity, are evidently what is generally meant by this nervousness.

Case 7.—One of the worst patients with antisocial behavior we have had to deal with in recent years gave us, when he was in his best mood, a vivid description of his own inner turmoil and its effect on him. When he thought of S. (a companion from whom he learned much that was unfortunate and whose name he could not remember at first) he became nervous. "I think of him and then I get all nervous and I bite my nails." "I don't know what's the matter with me; maybe I could get over it if I went somewhere else. Somehow I can't help it because I am so nervous; even when they get sore I bite them and keep on biting them. When I get nervous I want to steal. I'll be playing a game and will want to think of another game and everything will come up in my mind at once and I'll have to sit down." At another time this healthy looking country boy of 11 years, unusually strong for his age, in altogether a different mood, obviously tense and irritable, told us that he did not love anybody, he hated even himself, he would just as soon be sent to prison or anywhere, and our questions made his head ache. Much might be said about this case, about his arrest at 9 years for burglary and recently for burglary with a revolver in his possession, other stealing, about his irritability at home, unkindness to children and animals, wakefulness at night, complaints of feeling nervous, absolute self-centerment, even though completely gregarious. In the back ground, by way of possible causation, directly and particularly, was his association with a couple of bad companions, who stole and with whom he repeatedly had pervert sex experiences.

Placed in a private family for a few days' observation, this boy proved even more impossible than in his own home; he stole a valuable watch, was up at all hours of the night trying doors, broke up furniture, ran away—and so had at once to be sent away to a reform school without anything more constructive being done for him.

Case 8.—Another case with a better outcome was that of a boy, 13 years old, whose wornout mother asked that he be put away because of repeated stealing, truancy, troublesomeness and low marks in school, and his bad and nervous behavior at home. He was fidgety, restless, irritable, had occasional headaches and dizzy spells and seemed to have something on his mind, she told us. He had irregular habits of eating and coming home; had been biting his nails for a long time. In some ways he showed good traits; he was very nice to younger children, even to babies.

Seen by us, the boy proved to be poorly controlled both physically and mentally. He showed incoordinate movements of hands and body, bit his nails and fingers, seemed much worried and repressed. He cried when he was asked to do mental tests, answered questions rather incoherently, stated that he could not say what he meant, and his attention varied greatly. He told us that he felt so nervous sometimes that he put his fingers in his ears when the cars went around the corner. After inquiry he said that it was what happened under the wharves, watching homosexual affairs between the boys, "That's what got me nervous. One fellow showed me a picture, a photograph. The kids said it came from France. I guess it's that stuff made me nervous. Another kid has a picture I won't look at. It all makes me feel queer." He wanted to go to the country, he pathetically stated, because there perhaps he could forget those things and become more healthy. After this exploration the boy was sent to a relative for the summer and then he returned home. The school reports now for months have been the reverse of his previous record, his scholarship is fair, attendance perfect, conduct good. He is much less nervous and appears happy.

In not a few instances the delinquent young people we have studied have given us an account of "queer feelings" that seem to be definite nervous phenomena to them.

Case 8.—As an example we might take the case of a boy highly supernormal and alert mentally, who showed nothing unusual on the physical side, except somewhat poor color, a rather tired look, slight incoordinate movements of the hands, and some undue restlessness. Although only 10 years old, he had been stealing considerably over a period of four years. This dated back, we found from the boy, to the influence of a companion who taught him stealing and masturbation, the latter having been discontinued under the efforts of a woman with whom his mother boarded him. Concerning his queer feelings, of which he definitely informed Dr. Bronner, he said that they were caused by things he had been told at 6 years of age. "If I could forget the words." "They give me a funny feeling all over. They make me feel bad and if I wouldn't feel bad I think I wouldn't steal." It is over a year now since this boy for the first time revealed his inner mental life in its relation to his sensations and conduct. We lately have a report from his family, who brought him to us originally, that a wonderful change came over him at once and has been maintained. He has not stolen in all this time and he can now be trusted with money and is truthful and takes great pride in his honesty.

Case 9.—The queer feelings, the tenseness and the worry were felt by one boy as a sort of an attack, something coming over him, connected with ideas which arose evidently like obsessions in his mind. This was also a bright boy of 10 years, thoughtful and imaginative, who with his perplexed expression and his high-pitched voice appeared to be decidedly nervous and high strung. He had been stealing for two years in spite of good discipline and often sympathetic treatment. Just before we saw him he had looted his father's strong box at his shop, taking $118 in cash, checks and other papers. The checks, etc., he returned by mail and stayed away from home for a week, a rather desperate adventure for a very small boy.

Again, the boy's own words told the story we are here interested in. Although shortly given, they indicate a little of his really mature approach to his problem. "I get sore lots of times. Because that bothers me, see, about the boys. They tell me about the girls and robbing. They bother me, see, when they tell me about girls. Boys write things on the walls and they spell it out like this. It was on X place when I first heard it. I tried to forget it, but I couldn't. I can't leave go of it. I think and think and then I forget what I went to do. Sometimes I don't know what I'm doing, I'm so bothered. The worst is the bad things they say. That $118, I don't know for what I done it myself." Some months after our examination the father reported with much gratitude that there had been no further trouble with this boy.

As we should naturally expect, the general feeling of irritability may be expressed objectively by exhibitions of crossness or mean behavior to others.

Case 10.—A child of 8 years, who had been stealing much, setting fires dangerously several times, was mean to other children, quarrelsome and showed violent temper spells, said, "The words, I think of them, sometimes I say them to myself. When I think of them I get into mischief. The words make me

cross. I think of these words and of bad boys and I do everything I'm not supposed to. I feel mean when I do those bad things. I worry; I want to know what the words are."

Case 10a.—A sullen and evasive boy of 9, called unmanageable at home as well as a little thief, wrote certain words for us and says, "When I think of these I feel like everything, I feel cross."

Case 11.—Another pilfering boy of 11 years, active, restless, quarrelsome, domineering, did poorly under our observation for about a year, when our recommendations for placing him were not carried out. Then on further study of him we succeeded in getting facts that seemed to explain the causative background of his bad behavior, and since then the same observers report a great change for the better in his conduct under the same home circumstances. He blurted out, "Something is the matter with my mind. It's because I always have bad thoughts. They don't make me feel good. I feel cross. It's a word." "What is it?" "That's the trouble, I can't tell, I can't say the word because its a mortal sin. The priest says I should say a prayer and sometimes it helps and sometimes it don't." The boy wrote an Italian bad word, refused to write it in English, but said it begins with "f."

Case 12.—A still more specific example is that of a little girl of 11. About her temptation to steal she said, "I feel as if I was angry with them, some boy and girl, and then when I feel cross or angry I stretch out my hand and take it. I say to myself, 'If Johnny was stealing, I can take it if he could.' I feel angry before I take things, and then afterward I shake like everything." It would take pages to do justice to the mechanisms of this girl's associations as they were slowly developed in her self-revelation. She told how cross she became when boys or men tried to make up to her, she told of her irritations at certain phrases which suggested to her certain other bad things that she had heard boys say. She reiterated that it was her crossness aroused by either kind of experience that made her feel like stealing. The framework of this dynamic associative structure seemed to be as follows: Brought up in a home of great repression, she reacted, with extreme feeling and without confiding in anybody, to exhibitionism on the part of a boy whom we may call Albert. Some time later a second boy, Jimmy, said in her presence some obscene words to which she gave sex meaning. Then and ever since these words or other similar obscenities recalled this affair with Albert. Next in the associative structure was the fact that Johnny, who stole much, as she happened to know, was the chum of Jimmy. Without any other sex experience, the middle element, obscenity, or ideation concerning it, or casual contact with men or boys, or even their friendliness, recalled either or both of the other elements, ideation concerning exhibitionism or stealing. The crossness and anger that were aroused might then be relieved by stealing. "Now I think I can stop stealing," said this little girl a year ago, after a first day of resistance and a second day of unburdening. And she has.

Case 13.—Another little boy, of 8 years, complained of for excessive petty stealing, told us that he was a member of a secret service club and in recounting the activities of that organization of youngsters said that the bad words he heard "Make me feel rotten, I want to fight everybody I meet, my little sister; I feel cross. I go about like crazy. My brains make me steal when I don't want to." The story of his misconduct quite bore out his own description of his inner mental life; at home and elsewhere he seemed uncontrollable. His teachers reported him bright, attractive, likeable and that if let alone he seemed to go into a dream.

CASE 14.—A nervous manifestation of great interest as evidently related to the causation of a really desperately developing criminal career was found in the case of a boy of 13, referred to us by the Boston City Hospital. The boy had engaged in systematic stealing for years; it had been indulged in with periods of intermission since he was 6 years old. At times it had amounted to an orgy of thieving. Placed in an institution for the second time, shortly before we saw him, he had jumped out of a second story window, but was not seriously injured. The signs of his nervousness were appreciated by his parents, the family physician and at the hospital, but no explanation was forthcoming. One doctor had thought offhand that he might be defective and he was sent to Dr. W. E. Fernald, who found that he was not feebleminded.

The story of the boy's anomalous tendencies is long, but I give a short summary. He was quite honest at home, stealing elsewhere in spells. He was naturally very timid, not fond of athletics, and cried quite easily if hurt a little, yet in his stealing he had engaged in bold escapades. He was afraid of the dark, but had repeatedly slept out all night; once his father found him in a dog kennel. Sometimes he was gloomy and depressed though generally cheerful. He was reticent about himself, though talkative about exploits of other boys. He was generous, giving away anything, courteous and polite. He read many books superficially and had some artistic skill in painting and modeling. He had been nervous for years, biting his nails badly and biting his lips at times. He twirled his hair and picked at his hands constantly if his father took him to task. Sometimes at night in bed he shivered so that he shook the bed. Enuresis was present for a short time when he was 6 years old. (Careful inquiry brought out nothing that resembled epileptic attacks.)

He indulged in stealing strangely. He had taken many chances of being caught and being hurt and he had taken many things for which he had no use. For example, when he had a good bicycle of his own he stole several others, without attempting to sell them. He had done such things as breaking into a place to steal something he had seen through the window; he had made away with a package he saw in a carpenter's shop. He had taken money from school children and many things on many occasions.

It was the boy's own account of his behavior and experiences that was of main interest. At one period of our attempt to analyze with him his own career and reactive tendencies he said in response to our query whether he knew why he stole so excessively, "It's because of things I don't like to talk about." Concerning his ideas of stealing he said, "They come usually when I'm not busy, then I have to start jumping round and then I forget about it." Talking of his nervousness he said, "I see something and I shake till I take it." It was like the shaking he had in bed. Several times he told us he wished he could have some medicine that would cure his nerves. He thought he could stop stealing if he could get medicine so that he wouldn't shake. "It would keep me from planning these things. (When?) In the day time or at night. I mean if I am walking along and see something. Then something comes up. I have a nervous feeling and go and take it. I feel nervous all over. I would be looking all over and I would stand still and I don't know whether to take it or leave it there." In response to questions, he told us his heart beat hard then, he shook or shivered, and also had erections. And all this, which may be in front of a shop window, is the same sort of affair that goes on at night in bed. "And when I have that feeling in the toilet I get nervous too." And then he feels "like going out and stealing."

The shaking spells which were made so much of by the boy and his fairly intelligent father seemed most peculiar adjuncts to the situation. At the times when he has these spells he has in mind or has just had in mind, so he worked out the situation with us, a couple of boys who first taught him stealing. But even more vividly than his first experience in stealing with them at 5 years, which his father corroborated, for they were notorious youngsters, stood out in his mind his experiences with them when at about the same time on a couple of occasions in an old shed in a field they undressed him and initiated him in sex practices. They took off all their clothes together there. We hesitated much to suggest by direct questioning and he did not offer any statements of being cold and shivering on that occasion, which seems more than likely. He said that he was not hurt or frightened. He was not sure what time of year it was, but we have some intimation in the fact that it was about this time that he stole with them the first time, and the object was a snowshovel. It seems highly probable that his ideation concerning these other boys and the event in the shed in the field is also associated with subconscious memories of shivering, and the shivering recurs as well as thoughts about the boys.

At any rate, getting this whole affair clearly set forth and faced six months ago resulted immediately in complete cessation of stealing and of the shivering attacks. The father says, "He seems a changed boy."

Case 15.—Peculiar dizziness and nausea were part of the reactions of Tom, a supernormal nail-biting boy, 9 years old, to a situation which involved his brother. Dan, this brother, is a couple of years older, also a bright boy, and we had the opportunity of studying him also and corroborating the facts. Dan had a friend Jim and Jim taught Dan to steal long before Tom knew about it. Dan for a time stole much. Jim also taught him bad words which he passed on to Tom. The latter said he wouldn't say them, he didn't ever say them, he thought them and they made him dizzy. He had never told anybody about them; they made him feel queer; they made him feel sick; they made him steal. When Dan was at the table the words came into his mind and made him sick at the stomach and he couldn't eat. He left the table sometimes.

There is much in the record of this case, too, but in short it may be said that the situation at home was so acute that we advised that this boy be placed elsewhere after this exploration. He did very well, even though his statements to us from time to time evidenced that his brother was much on his mind. We appealed to Dan concerning the use of bad words and then Tom went home and has done wonderfully well for a long time. No more stealing, no nausea is reported. He does not bite his nails so much.

The stuation is especially interesting because of the different reactions in the two boys. Dan had stopped stealing before we knew him; he did not repress the words; he did not worry about them; he was altogether an objective little chap; he had no mental conflict.

OTHER PHENOMENA ASSOCIATED WITH CONDUCT DISORDER

There are other phenomena that deserve at least some mention: Occasionally tics must have significance for us as not fortuitously occurring in connection with delinquency, as in the instance in which a boy said that not only his impulses to steal but also his twitching of the face and half-shrug of the shoulders followed a miserable experience with an older delinquent. He said, exhibiting his tic, "Its when I

think of him that I do like this." Or it certainly indicates something when a wholesome-looking little girl, who repeatedly steals even directly after punishment, persistently looking at the ceiling when questioned, not answering although compressing and moving her lips, furiously wrings her hands. The latter action, indeed, had been rightly recognized by teachers and others as a sign of nervous or mental disturbance in her case.

A boy, reported nervous, says that he is so nervous that he shakes or gets hot and sweaty and has intestinal symptoms as he thinks of stealing and of the circumstances that surrounded his earliest acquaintance with stealing. The nervous symptoms peculiarly disappear in the act of stealing; there is no excitement and no fear afterward, as one would naturally expect. He is another boy that pleads for a chance for a quiet life.

Stuttering is so genetically related to character abnormalities in certain cases of delinquency that it has received special recognition by neurologists and psychologists. And the same is true of hysteria—we need not dwell on the protean manifestations of this condition as connected with delinquent careers.

IMPORTANCE OF MENTAL CONFLICT IN CONDUCT DISORDER

There is much that is of incidental interest in this whole discussion; for example, the peculiar perplexity and concern of these young people about their own mental affairs, the fact that so many of them are far above the average in mental ability, their frequent forgetfulness of the names of persons whose memory is bound up with their earliest experience with delinquency and unpleasant feelings, their great resistance to sex words, being willing, however, to write them or say the first letter, their own reaction to their own story—some have asked to be allowed to continue at another time because there is more to tell—the strong signs of repression with many, the emphasis which they place on their own feelings of queerness, so unusual in children. Only rarely have dreams seemed to be of value to us in getting at essential causations.

Thus, in connection even with a form of delinquency in which we should least expect it, we find many nervous phenomena—feelings of worry, of being bothered, of depression, of tenseness and general nervousness and excitement. And more definite symptoms—dizziness, headaches, nausea, nervous exhaustion—are reported. Plainly to be observed are biting of the nails, pulling out of hair, marked restlessness, shaking and shivering attacks. During analysis of the case all these are clearly stated by the subject to be specifically related to certain ideation recognized as undesirable. Perhaps there is nothing

any more remarkable in this than that physical or specifically nervous signs and sensations accompany other ideation with emotional context, events in sex life, thoughts accompanied by anger, fear, embarrassment, etc. At any rate it comes about that recognition of the significance of these nervous signs leads, in not a few instances of delinquency, to unearthing etiologic facts and experiences that are of prime importance for making over the individual, nervously and morally.

I have set forth elsewhere that just such a background as is depicted in the cases cited may lead to a prolonged career of misconduct, even of criminality. The establishment of habit, of a set of mind goes on here as elsewhere. Perhaps the nervous symptoms tend to decrease or cease during the course of years, while delinquencies persist, but we have seen numerous instances of their continuance well into adolescence and sometimes to young adult life. There is no escaping the fact that this type of a career, neurotic and delinquent, is a matter of grave concern, not only to the individual and the immediate family, but to society in general.

Intensive study of a large number of young delinquents has led to the conclusion that about 10 per cent. are sufferers from the inner turmoil that we call mental conflict. It is to the importance of this field and the remarkable possibilities of therapeutic accomplishment that I wish to call attention by stressing cases in which the essential disturbance for some reason has the above outward manifestations or indicators.

News and Comment

ASSOCIATION FOR RESEARCH IN NERVOUS AND MENTAL DISEASES

The Association for Research in Nervous and Mental Diseases was conceived more than a year ago and organized during the following months. Its object is indicated by the title, and it is to be national in scope. The present plan is to have one meeting a year, the subject to be discussed and the contributors being chosen by the program committee. The scientific proceedings are conducted by a commission, members of which may ask questions and require an author to defend his thesis. The commission finally assembles, edits, if necessary comments on, the communications, and publishes all in a volume which is sent to every member. The undertaking is a distinct step forward in American neurology.

The present officers are: president, Dr. Walter Timme, New York; vice president, Dr. E. W. Taylor, Boston; secretary-treasurer, Dr. Foster Kennedy, New York; members of the commission, Drs. Walter Timme, Pearce Bailey, Charles L. Dana, Bernard Sachs and Frederick Tilney of New York; E. W. Taylor of Boston and T. H. Weisenburg of Philadelphia. There is a program committee of eleven members.

The first meeting will be held at the New York Academy of Medicine, December 28 and 29, 1920, at 9:15 a. m.

PROGRAM

Presidential Address, Dr. Walter Timme.
Etiology and Epidemiology, with Especial Reference to the Alleged Relationship Between Influenza and Lethargic Encephalitis, Dr. George A. Soper.
Serology, Dr. Walter M. Kraus and Dr. Irving H. Pardee.
Pathogenesis and Experimental Pathology, Dr. Harold L. Amoss, Dr. Israel Strauss and Dr. Leo Loewe, Dr. William Thalheimer.
Morbid Anatomy:
- Microscopic and Naked-Eye Appearances of the Nervous System in Lethargic Encephalitis, Dr. William G. Spiller, Dr. James B. Ayer.
- Morbid Anatomy Outside the Nervous System, Dr. William Boyd.
- Brain Lesions from Inorganic Poisons Like Lead, Dr. G. B. Hassin.

Clinical Studies:
- Prodromes, Dr. I. Abrahamson.
- Paralysis Agitans and Thalamic Types, Dr. J. Ramsay Hunt.
- Cerebral Types, Dr. J. W. McConnell.
- Cerebellar Types, —— ——.
- Spinal Types, Dr. Henry Alsop Riley.
- Radicular and Peripheral Types, Dr. Foster Kennedy.
- Treatment, Dr. Edwin G. Zabriskie.

Prevention:
- Immunology, Dr. Harold L. Amoss.
- Psychotic Types, Dr. George H. Kirby and Dr. Thomas K. Davis, Dr. Menas S. Gregory.

Studies on the Question of the Relation Between Poliomyelitis and Encephalitis, Dr. William B. Cadwalader, Dr. I. Neustaedter.
Diagnostic Criteria, Dr. Lewellys F. Barker.
Prognosis, —— ——.

Additions to Physiologic Knowledge Through Syndromes of Lethargic Encephalitis, Dr. Frank H. Pike.
Ocular Manifestations, Dr. Ward A. Holden.
Vestibular Manifestations, Dr. Isaac Friesner.
Statistical, Dr. I. S. Wechsler.
Bibliography, ——— ———.
Encephalitis Among the Feebleminded, Dr. Karl Menninger.

For information regarding membership, the program or other matters, communicate with Dr. Foster Kennedy, 20 West Fiftieth Street, New York.

Abstracts from Current Literature

APHASIA AND KINDRED DISORDERS OF SPEECH. Henry Head, Brain **43**:87, 1920.

Head, in the Linacre lecture for 1920, comes to certain conclusions as a result of his studies of soldiers injured during the war. The material consisted chiefly, though not entirely, of young men, many of them intelligent, well educated officers. Nothing is said of the pathologic and anatomic investigations which were doubtless thorough and extensive, but reports concerning which are reserved for other communications. We know nothing of the lesions in these cases except that they occurred in one half of the brain, which half is not mentioned nor is it mentioned whether the patients studied are right or left handed. The study is clinical and psychologic and the methods employed in investigating the cases are reported in detail. The author draws a close analogy between his studies of cortical sensations and the findings in his cases of aphasia. He looks on the results in aphasic states in the same light as the partial disturbances resulting from injury to the cortical sensory area. Destructive lesions of the sensory cortex, the author points out, do not result in complete sensory loss of discriminative cortical types of sensibility but rather in irregularly distributed and partial losses. This is true also in hemilateral injury to the cortex of the brain. The speech mechanism is not lost entirely but partially and the disturbance is made manifest in certain fairly definite ways which he classifies under the terms (1) verbal defects (old term, motor aphasia), (2) nominal defects (old term, verbal amnesia or sensory aphasia, paraphasia), (3) syntactical defects (old term, jargon aphasia, paraphasia), (4) semantic defects (old term, verbal amnesia, word deafness, word blindness, alexia, paralexia, agraphia, paragraphia).

Head strikes a tremendous blow at present day conceptions of aphasia and speech development when he reiterates the dictum that there is no memory for words, apart from the thing remembered. He says there are no images of words and no memories of words heard, seen, spoken or written; and speech disturbances cannot be discussed in terms of motor aphasia, alexia or agraphia. The so-called motor aphasic patient has a disturbance of speech in its broadest sense, and careful examination, according to Head's method, shows invariably that we are dealing with a disturbance in some part of all the elements of speech in every case of aphasia. It is not a pure anarthria, as Marie claims, nor a general lowering of special intelligence as it applies to speech (Marie's and Wernicke's sensory aphasia), but all true aphasias show a disturbance of the speech mechanism in its broadest sense.

The author insists that cortical stimuli produce inconstant responses; therefore he emphasizes the necessity of repeatedly applying the tests mentioned below to bring out the speech defect. The author's tests are described in detail in pages 90 to 106. Some are original. The tests are: (1) the naming and recognition of common objects; (2) naming and recognition of colors; (3) the man, cat and dog test. These words of three letters are employed in various combinations, and then the patient is asked to write and read the various combinations and to repeat them after the observer; (4) the clock tests—setting the hands according to command, by imitation, etc.; (5) the coin

bowl test—placing coins in a bowl according to written or spoken command, etc.; (6) the hand, eye and ear test—the patient obeys the spoken or written command, or imitates the observer, being seated in front of him, or imitates reflected movements, the observer and patient facing a mirror.

This test is most important, according to Head, because he noted frequently, in the patients tested, a want of appreciation of crossed movement. This is caused by the necessity to repeat the words of the spoken, written or motioned command in order to imitate the observer correctly. Besides these tests, the author had his patients repeat the alphabet or read aloud a story and repeat its contents, read from dictation, etc.

The author disagrees with previous explanations of aphasia. He thinks that "Gross injury confined to one cerebral hemisphere can disturb the power of speaking, reading and writing, without producing any other severe loss of intellectual capacity." A group of functions exist which are "Indispensable for language . . . but not essential for all intellectual performance." The author looks with extreme doubt on reported cases of pure "alexia," "agraphia," and "aphasia." These terms pass out of existence with the passing of the "faculty" doctrine. Inability to speak, read or write, is always associated with some other loss of the speech function. These disorders are not due to the destruction of "images." The images are not lost but the use of the words (symbols) are lost in speech (symbolic expression).

The differences between various forms of disordered speech are due to the breaking up of one aspect of symbolic expression and thinking analogous to the sensory dissociations which follow lesions of the post central cortex. The residual defect after neural shock passes away is the type of dissociation existing in the individual case. Some aspects of speech are more affected than others in these various types, and Head has chosen a name for each of these to express the grammatical error characteristic of each type. He admits, however, that the disturbed functions extend "Beyond the limits of verbalization." However, one can summarize the defects by saying that in "verbal aphasia, words are evoked with difficulty and tend to be abnormal in structure. Nominal aphasia leads to a defective use and understanding of words as names or indicators. Loss of syntactical power disturbs the internal balance of a word as an orderly rhythmic expression and so leads to jargon; whilst semantic disorders interfere with the capacity to comprehend and retain the general significance of a word as part of a complete act of language."

Nothing positively helpful to an understanding of this difficult and interesting subject has been brought out in this article. The author promises further elaboration of the subject in subsequent more important, anatomic, pathologic, psychologic and clinical reports.

OSNATO, New York.

THE CLINICAL SIGNS OF NERVE INJURY AND REGENERATION.

LEWIS J. POLLOCK, Surg., Gynec., & Obst. **30**:472 (May) 1920.

The author states that clinical signs of nerve regeneration are manifestations of the spontaneous recovery of an injured nerve, the recovery consequent to the suture of the ends of a divided nerve, or recovery following some operation on an injured nerve which has shown signs of physiologic interruption. To a large degree, signs of regeneration consist in the evidence of return of function.

Many attempts have been made to discover a sign or group of signs which would justify a rapid differential diagnosis between a patient with a complete

section of a nerve and one in whom complete loss of function is not the result of division of the nerve. The syndrome of compression, irritation, etc., adopted by Mme. Déjerin and J. Morizon have been proved by others to be artificial and unreliable for the purpose of certain diagnosis.

Complete loss of function due to anatomic interruption cannot be differentiated from loss of function due to physiologic interruption produced by compression, etc. By a single examination, it can be determined only whether the lesion is complete or incomplete. If complete, one cannot tell whether it is due to anatomic interruption or not, nor predict whether it will recover spontaneously or require surgical treatment. When subsequent examination reveals some return of function, and only then, can an incomplete lesion be diagnosed.

The author discusses the symptoms of complete interruption of a nerve as given by various authors and comments on the lack of standardized methods of examination; careless and verbose description and lack of knowledge of the physiology of the peripheral nervous system are exhibited by many authors on the subject. There are several degrees of loss of function, believed by the author to be the most important indications in determining the severity of a peripheral nerve lesion:

1. Complete loss of all functions of the nerve indicates a severe lesion and is interpreted as complete physiologic interruption of that nerve.

2. Total paralysis of all the muscles supplied by a nerve distal to a lesion cannot alone be used as an indication of the severity of that lesion.

3. Motion of segments about a joint does not indicate the integrity of the function of the nerve supplying the muscles ordinarily supposed to move such segments.

4. The preservation of certain movements, the loss of which is supposed to follow particular nerve lesions, may be supplemented, and lead to incorrect opinions that complete lesions are incomplete ones.

5. Only when sensation (pin prick) in the isolated supply of a peripheral nerve is present can the lesion be considered partial. In this area no overlapping of adjacent nerves occurs, and in complete lesions sensation to pin prick is absent. The author has been able to reconstruct the isolated supply of several peripheral nerves.

6. Complete reaction of degeneration is always present in severe lesions, but does not indicate an irreparable one.

The slowness of muscular contraction is the only constant phenomenon which can be satisfactorily employed in determining the reaction of degeneration. Polar changes are inconstant, and are frequently absent even in partial lesions. The rapidity and extent of muscle atrophy may be taken as a guide to the severity of a nerve lesion with certain reservations. The author compared the amount of atrophy by water displacement in partial and in complete lesions, the severe lesions showing a higher percentage loss of muscle substance but not enough to be of diagnostic value. Presence or absence of pain on pressure over the nerve distal to the lesion was found an unreliable test as was also pain on pressure over the paralyzed muscles. Loss of tone as measured by the tonometer is present only for a short time after the injury. Trophic disturbances are of value as an indication of the severity of the lesion when judged in the light of the presence of other conditions.

The signs of regeneration are different in spontaneous lesions and in those following resection and suture. In rapidly and spontaneously recovering lesions, pain and tactile sensation return simultaneously and in patches in isolated supply. There is no definite order in the return of the muscles, and

it does not depend on the distance from the lesion. Slow and delayed cases that recover spontaneously act like sutured nerves, the muscles recover from above downward. The order in which signs of regeneration occur as given by Mme. A. Benisty are: (a) sensory regeneration, consisting of pain when the skin is pinched, pain when the nerve is pressed below the lesion, formication on pressure of the nerve and spontaneous aching in certain muscles; (*b*) arrest of atrophy and return of tonicity; (*c*) in some cases, return of faradic contractibility; (*d*) disappearance of objective sensory disturbance, and (*e*) voluntary movements.

In the author's experience, return of pain on pinching the skin can be used as an indication only when in the area of isolated nerve supply. A sensation of a different feeling often precedes other signs. Pain on pressure on the nerve trunk distal to the lesion was found unreliable. Tinel's signs were found to be practically valueless. Return of sensibility to pain has always been accompanied by return of sensibility to touch in the isolated supply of a nerve. The author believes that return of sensibility to pain without sensibility to touch only occurs in the area of nerve overlap and is due to the overlap in the area of anatomic sensory supply.

In primary suture, the first return of motion in musculospiral cases was six months; in external popliteal, seven months; in sciatic, six and one-half months. In secondary suture, motion returned in the musculospiral in from five to six months, and in the sciatic in six and one-half months. The author regards as a certain sign of nerve regeneration the disappearance of the reaction of degeneration, the return of objective sensibility in the isolated supply of a peripheral nerve, and the return of motion.

OTT, Rochester, Minn.

LA PSYCHO-ENCEPHALITE AIGUE EPIDEMIC ET LES TROUBLES PSYCHIQUES DE L'ENCEPHALITE AIGUE, DITE LETHARGIQUE (EPIDEMIC ACUTE PSYCHO-ENCEPHALITIS AND THE PSYCHIC DISORDERS OF ACUTE, OR SO-CALLED, LETHARGIC ENCEPHALITIS). HESNARD, Encéphale **15**:443 (July 10) 1920.

Concerning the mental symptoms in epidemic encephalitis, the writer distinguishes two clinical groups: first, the mental symptoms that arise in encephalitis in its common (and numerous) forms (oculolethargic, polymyelitic, neuritic, tetanic, choreic, myoclonic, etc.), and second, the mental symptoms in those so-called encephalitic psychopathies which Hesnard chose to name epidemic acute psycho-encephalitis.

Mental symptoms if not constant are at least frequent in epidemic encephalitis. The "sleep" in these cases resembles a veritable "twilight state," analogous to certain hypoconfusional syndromes. It is more a "psychosis of closed eyes" than true sleep.

The large group which Hesnard thinks of as encephalitic psychopathies, and would keep quite separate, is divided into five subgroups in his experience: 1, psychosomnolent; 2, lucid catatonic stupor; 3, acute delirious types; 4, confusional forms properly speaking, and 5, Korsakoff types.

1. Psychosomnolent forms. These cases, on a basis of hypersomnia, accompanied by a neurologic syndrome, mesencephalic or otherwise, develop psychic disturbances, often consisting of slight excitement, or sometimes hypomania, passing into confusion. Then the patient passes into a clearly depressive stage. In some instances, the confusion, and with it a more or less massive intel-

lectual obnubilation, arises so brusquely as to give clinically the picture of general paralysis during the invasion period.

2. Forms with lucid catatonic stupor. The patient is impassive, the expression vacant. There is simple catatonia. He has lost "psycho-minic mobility." The life of his physiognomy, as his general muscular activity, has been suspended. There is a viscosity of voluntary activity. The catatonia is genuinely psychomotor and not (as occurs in other pseudoparkinsonian cases) primarily explained by a muscular rigidity alone. In other words, its psychic factor is actual. But, and the writer says it is a curious thing, these patients are nevertheless habitually lucid and cannot be said to be confused. In total, it may be said regarding catatonia in encephalitis that one kind seen can be regarded as true, and does not lack a psychic basis. The other kind is false inasmuch as it is merely a more or less necessary result of muscular rigidity.

3. Acute delirious forms. The delirium may be frankly hallucinatory, with sometimes an alarming general state. Even when collapse threatens, it is rare to find meningeal reactions. In brief, this state is analogous to a febrile delirium tremens.

4. Confusional forms, properly speaking. "The mental confusion which is most frequent is a psychic torpor, which, when it becomes ameliorated to a degree, shows itself in the form of a bradypsychic syndrome." (In this section, in spite of its title, the author fails to talk about confusion. The latter is really discussed in Subgroup 5, which follows.)

5. Korsakoff forms. The Korsakoff syndrome (with disorientation and a certain degree of confabulation) is encountered in prolonged forms of diffuse encephalitis, sometimes accompanied by neuritic symptoms or more frequently still by poliomyelitic symptoms. The symptoms usually represent either a bipolar psychoneuritic association or a bipolar psychomedullary association. There are instances without either neuritis or myelitis. From this, one concludes that the Korsakoff syndrome is not obligatorily neuritic. Certain psychopathic sequels belong here, comprising a state of psychic enfeeblement. Without interest, curiosity or initiative, though conversing voluntarily and with good sense, one patient continually believed herself to be in another city. She took unto herself no new memories and made no effort to "grow precise regarding her situation." It was a condition comparable to those cases (with a destructive lesion, arterial or otherwise) in which the connections of the frontal lobes with other cortical areas are interrupted.

Psychic sequels sometimes assume other forms, especially in children. In them Cruchet of Bordeaux has found intellectual inappetence, difficulties of learning, and also disturbances of character and disposition, the permanency of which only the observations of the future will establish.

DAVIS, New York.

THE ROLE OF DEEP ALCOHOL INJECTIONS IN THE TREATMENT OF TRIGEMINAL NEURALGIA. HARVEY CUSHING, J. A. M. A. **75:** 441 (Aug. 14) 1920.

The author reviews thoroughly the history of deep alcohol injections in the treatment of trifacial neuralgia. Injection of the nerves with some tissue fixative was first practiced as a means of controlling neuralgias. Various substances were used for this purpose. Chloroform was introduced by Bartholow in 1874, and osmic acid was proposed ten years later by Billroth

and Neuber. Pitres and Verger of France were the first to introduce treatment by the injection of alcohol; further developments in this method were made by Levy and Badoin, and later by Patrick.

The results obtained from alcohol injections are necessarily limited. The relief is only temporary, and, with each successive injection, a shorter interval of freedom from pain is likely to be secured. The procedure is, however, less hazardous than avulsion of the peripheral branches. Paralysis of the oculomotor nerves is the most common complication. Stiffness of the jaw, paralysis of the motor fifth, sloughs into the soft tissues and bones, hemorrhage, and facial paralysis are other possible complications; accidental injection into the middle ear is not unheard of, and the resulting trouble is most distressing.

The author condemns injection of the ganglion, since it is impossible to control the extent of alcohol infiltration, and the postoperative complications are most serious. Motor paralysis of the fifth, secondary keratitis, and meningitis are the most frequent complications.

His conclusions are:

1. Deep extracranial injections of alcohol into the maxillary and mandibular nerve trunks near their foramina of exit from the skull have completely superseded peripheral neurectomies.

2. In neuralgias which are limited to one of the two lower divisions and which may possibly not extend into the other trigeminal areas, alcohol injections represent unquestionably the treatment of choice.

3. When the neuralgia has spread beyond its original area and come to involve that supplied by the adjacent division, a trigeminal neurectomy must be contemplated; but if no preceding deep injection has been given, it may be useful not only in insuring the type of the neuralgia but in giving the patient some warning as to what the numbness resulting from the neurectomy may amount to.

4. Deep alcohol injections are sometimes useful, furthermore, in determining in doubtful cases whether the syndrome is a true neuralgia of the tic douloureux type or one of the peculiar and rare pseudoneuralgias not amenable to relief either by injections or neurectomies.

5. Even the extracranial injections are not entirely free from risk, and in no case should they be pushed to the point of attempting an injection of the gasserian sheath itself.

6. In consideration of the perfect and permanent results secured today by a trigeminal sensory root avulsion, the prolonged and repeated use of injections in refractory cases which involve more than one division should be deplored.

Adson, Rochester, Minn.

LA CONFUSION MENTALE D'ORIGINE PUERPERALE (MENTAL CONFUSION OF PUERPERAL ORIGIN). R. Dupouy, Bull. méd. **34**:722 (Aug. 14) 1920.

Puerperal psychoses are the psychoses due to auto-intoxication or infection coincident with pregnancy or the puerperium, having confusion, in one of several varieties, as the type clinical form. Certain psychopathic manifestations constitute an apparent exception to this rule. A number of women during their pregnancy develop "envies" (inclinations) sometimes even impulsions. These are puerile or absurd desires, the nonsatisfaction of which provoke phenomena of anxiety. Related to these are such fears as of bringing into the world a child which is "marked." Such manifestations are not accom-

panied by confusion. They are on a par with the headaches and vomiting of pregnancy, and appear along with the classic symptoms of gravid autointoxication. Such "envies" correspond in rough sketch to the mental automatism which may succeed them, just as the accompanying somnolence, headache, lassitude, etc., represent in preliminary outline the confusional syndrome itself.

The two main groups of the confusional syndrome are the true manifestation of puerperal psychosis—mental confusion by autointoxication—and mental confusion dependent on puerperal infection. The mental confusion by autointoxication appears in the third or fourth month of pregnancy and by the seventh month assumes the intensity which forces special care. At first, there is a simple embarrassment of voluntary exercise of the intellectual faculties, and somewhat later, more and more memory errors. Gradually, the patient fails to understand well what is said to her. She speaks hesitatingly, asks childish questions and has vague ideas. Some arrive at mutism, confusional stupidity and catatonia. In other cases various ideas of persecution and of influence make their appearance. Delirium is fed by hallucinations, chiefly visual, and often a paroxysm of hallucinations lets loose a reaction, anxious or impulsive.

In the gravid woman an apathetic mental confusion is the rule. It is after the delivery that the restless hallucinatory delirium installs itself. If the latter arises, it is always possible to trace back and find the former during the actual gestation.

The author advises thyroid opotherapy for cases that occur during the gestation period but in the cases following delivery he advises ovarian therapy which has been preceded by thyroid treatment.

As regards the second group, the writer believes that confusional states are induced by puerperal infection only in women who are constitutionally predisposed. In these cases confusion is accompanied by wild agitation. The patients are delusional and hallucinatory and are in danger of harming themselves. He has never seen a Korsakoff type of psychosis occasioned by an infection in the puerperium.

The diagnosis of a puerperal confusional state is easy when the signs of infection are evident and the history is open. When there has been a clandestine abortion, the situation is more difficult. This emphasizes the need of a gynecologic examination, and indicates the needed surgical care of the patient in conjunction with psychiatric oversight.

DAVIS, New York.

UEBER MYOTONISCHE DYSTROPHIE (MYOTONIC DYSTROPHY).

KARL HITZENBERGER, Monatschr. f. Psychiat. u. Neurol. **47**:249 (May) 1920.

Under this heading the author reports a case, with postmortem findings, which belongs to the group of atrophic myotonia (Steinert). He prefers the term myotonic dystrophy, from the belief that these cases are primary dystrophies, with a secondary, symptomatic myotonia. According to Steinert's description, such cases show: myopathic facies, atrophy of muscles of forearm and hand, of sternocleidomastoids, of lower extremities and of the bulbar muscles, myotonic reaction, partial baldness, atrophy of testicles and vasomotor disturbances.

Hitzenberger's patient was 38 years of age. The family history was negative. Onset occurred at the age of 24 with myotonic symptoms in the small hand mus-

cles. The fully developed picture showed: myopathic facies; extensive dystrophic changes in the muscles of the forearms and legs, with absence of such changes in the upper arms and thighs; myotonic changes only in the thenar muscles, which in addition to the myotonic reaction, also showed a mysthenic reaction. Death resulted from pulmonary tuberculosis.

The necropsy findings were: Brain: no gross or microscopic changes. Spinal cord: number of cells considerably reduced; many cells small, shrunken, and poor in tigroid bodies. Some cells showed pigment increase. The author found no evidence of degeneration of the fiber tracts, in distinction to Steinert, who found tabiform degeneration in the posterior columns and no cell changes. Muscles: an elaborate description is given of the histologic changes. The affected muscles showed hypertrophy, atrophy and degenerative changes. There was an enormous increase in the number of muscle nuclei, which lie not only in the periphery but scattered through the whole body of the fiber. There was extensive increase in the fibrous connective tissue. Atrophic changes in testicles: no changes in parathyroids, thyroids, suprarenals, pancreas or thymus.

SELLING, Portland, Ore.

SUR LES NEVRALGIES DE LA TETE ET LEUR TRAITEMENT PAR L'ECRASEMENT DES POINTS DOULOUREUX (NEURALGIAS OF THE HEAD AND THEIR TREATMENT BY COMPRESSION OF THE PAINFUL POINTS). W. JANOWSKI, Presse méd. **28**:537 (Aug. 7) 1920.

Trigeminal and occipital neuralgias often appear in the guise of "ordinary," that is, "vasomotor" headaches, and their true nature is not detected because of neglect to palpate the points of emergence of nerves which should be under suspicion. If pressure is applied over each of these points during or immediately after the headache, a resulting violent and radiating pain throughout the area of distribution will determine the presence of neuralgia in the branch tested. Headaches reacting positively to this test, even some migraines, together with frank idiopathic neuralgias, can be grouped as available for the compression method of treatment. One is warned against including any neuralgias secondary to a demonstrable pathology—dental, intracranial, etc.

The therapeutic technic is as follows: The operator holds the patient's head firmly with one arm, keeps a finger of his other on the painful point, and exerts very strong pressure on it for one-half to one second, repeating the compression ten times at intervals of one second. This treatment is given once a day for a series of six successive days; the series is repeated several times with two resting days intervening. From five to ten series are found to effect a cure in obstinate cases of long standing. Early cases have recovered in ten or twelve days, with less than two series of treatments.

The severe pain associated with such a procedure is admittedly a handicap, but is partly overcome by the concomitant administration of acetylsalicylic acid, codein or other sedatives for the first few days. An alcohol injection is much more painful, and need not be given except as a last resort, if the compression method is accorded a fair trial.

HUDDLESON, New York.

THE LATE TREATMENT OF GUNSHOT WOUNDS OF THE HEAD.

H. H. KERR, Surg., Gynec. & Obst. **30**:550 (June) 1920.

The author emphasizes the advantage of using osteoperiosteal grafts in relief of the "defect syndrome" presented in cases of skull wounds which involve the brain. While very little is accomplished in the presence of organic brain lesions, a group of symptoms, constituting the defect syndrome, is relieved by removal of the bone deformity.

The author says of patients suffering from skull defects: "They are morose, retiring, and avoid their fellows. They suffer more or less from headache. Stooping over or turning suddenly will produce dizziness. Loud noises are extremely irritating. Exposure to the sun produces headache and prostration. Perhaps the fear of injury and the knowledge of incomplete protection to their brains contribute to this characteristic train of symptoms."

The author advocates the use of local anesthesia. The requirements of successful bone grafting are best obtained by sewing the graft to the pericranium with the bone surface inward. Operation should be delayed for at least three months after healing; in cases of osteomyelitis of the skull, it is advisable to postpone bone grafting until at least six months after healing of the wound. Regulated and directed exercise together with massage of the partially paralyzed extremities should be instituted, preferably in connection with play, since better cooperation is obtained in this way than if prescribed as a strictly therapeutic measure.

Plastic surgery on skull defects is at best unsatisfactory. Although some patients gradually improve, the condition of many remains unchanged. Unless the patients have a very large and disfiguring defect, operative interference should not be enthusiatically urged.

ADSON, Rochester, Minn.

NORMS FOR SOME STRUCTURAL CHANGES IN THE HUMAN CEREBELLUM FROM BIRTH TO OLD AGE.

ROBERT S. ELLIS, J. Comp. Neurol. **32**:1 (Aug. 15) 1920.

Neuropathology has always suffered from the handicap of inadequate knowledge of the healthy norms. The comprehensive studies of growth at the Wistar Institute are contributing valuable data in this field. Ellis has undertaken a study of the human cerebellum from this standpoint. In a paper published in the *Journal of Comparative Neurology* (vol. 30, 1919) he reported the results of quantitative study of the Purkinje cells in normal, subnormal and senescent persons, finding that the number of these cells is deficient in idiots and imbeciles and that the number decreases progressively in old age. These data are considerably amplified in Ellis' recent article, with tables and graphs showing the following relations:

At birth the cerebellum is small in comparison with the cerebrum, but at the age of 15 months the parts of the brain have approximately the same relative weights as those of the adult. The relative weight of the cerebellum does not vary significantly with stature, sex, race or intelligence. Between birth and the age of 15 months the layer of external granule cells disappears, the Purkinje cells grow to normal adult size, the molecular layer and internal granular layer assume the same relative widths as found in the adult, and the myelin sheaths grow rapidly, especially at the end of the period. These changes are to be correlated with the fact that about this time the motor activity of the child is increasing rapidly and he is beginning to walk. With the begin-

ning of senescence there is a loss of Purkinje cells and a resultant loss of myelinated fibers. With the structural change is to be correlated the loss of strength and of muscular coordination which is characteristic of old age. There is some indication that in senescence the right cerebellar hemisphere loses more cells than the left, due perhaps to the effects of excessive use of the right half of the body.

HERRICK, Chicago.

PRESENTATION D'UN OCULO COMPRESSEUR MANOMETRIQUE (A MANOMETRIC OCULO-COMPRESSOR). J. ROUBINOVITCH, Progrès méd. **35**:367 (Aug. 21) 1920.

The author has perfected the ocular compressor which he originated in 1916, and he describes it in detail. A leather band fitted about the head holds in place over each eyeball an oval elastic air chamber. These are inflated by means of an ordinary hand bulb placed at the terminal of an attached T-shaped set of rubber tubing. A spring-manometer, reading in centimeters of mercury, is inserted in the system. A three-way stopcock at the point where this is inserted permits one to keep constant pressure on the eyeballs for a time if that is desired. Other stopcocks make it possible to compress one eye at a time.

When the apparatus is in place over the eyes, using the manometer as a constant guide, one raises the pressure to a point not above 30 or 35 cm. of mercury. With a certain degree of ocular compression, variable with each individual, one obtains oscillations of the needle on the manometer synchronous with the pulse.

The real function of the apparatus lies in the study of the oculocardiac reflex, and by it curves can be charted showing the cardiac pulsations per minute under the influence of a series of compressions of different intensities.

Mougeot, in 1914, and others since, have shown the therapeutic value of the oculocardiac reflex in tachycardias, in (certain) tremors and in abnormal movements (athetoid).

DAVIS, New York.

UEBER ZOANTHROPY (ZOANTHROPY). C. SCHNEIDER, Monatschr. f. Psychiat. u. Neurol. **48**:269 (May) 1920.

The patient, a woman of inferior mentality, aged 31, developed an anxiety state following roentgen-ray treatment (for uterine hemorrhage). Hysterical attacks and a hysterical dream state followed. During the latter she saw three dogs which were trying to devour her. She developed an outspoken zoanthropic attack—imitating the actions and barking of a dog.

The author reviews briefly the literature on the subject, both ancient and modern, referring especially to the outbursts in epidemic form. He separates the cases into two groups:

1. Simple imitation of animal sounds, due to a respiratory muscle cramp, analogous to other types of hysterical spasm; no clouding of consciousness.

2. Zoanthropy; imitation of animal sounds and acts, accompanied by clouding of consciousness. These are closely related to the hysterical dream states. A fear element is practically always involved. Between the psychic trauma and its conversion into a zoanthropic attack, a latent period elapses. At first the outbursts are brought on only by something that can arouse a memory

picture of the original exciting incident, but later the associations leading to attacks become more remote, and finally the attacks become independent of external factors. The author attempts to make an analysis of the origin, development and fixation of the attacks, with special reference to: (1) the relationship to occurrences of normal life, and (2) the special reasons for its development in hysteria.

SELLING, Portland, Ore.

THE EXTENT OF THE FLOOR PLATE OF HIS AND ITS SIGNIFICANCE. B. F. KINGSBURY, J. Comp. Neurol. **32**:113 (Aug. 15) 1920.

This paper proposes an important modification of the plan of morphologic analysis of the brain suggested by His. A rational basis for the division of the brain into epichordal and prechordal portions is afforded. The floor plate of the neural tube is primarily coextensive with the notochordal plate and the floor plate corresponds with a sutura neurochordalis (His). The neurochordal suture does not extend to the anterior end of the neural plate and the primary sensory and motor zones are continuous from side to side cephalad of the anterior end of the floor plate. This involves a reinterpretation of the morphology of the forebrain and midbrain. The floor plate is regarded as terminating in the fovea isthmi at the anterior end of the midbrain floor; the motor zones terminate with the midbrain; the boundary between sensory and motor zones terminates near the mammillary recess; the optic chiasma marks the anterior end of the neural plate; the sensory zones extend farther forward than do the motor zones; and the region from which the retinas are derived lies in the most rostral part of the neural plate. The last conclusion is correlated with the studies on experimental cyclopea of Stockard.

HERRICK, Chicago.

MENTAL DEFICIENCY; ITS FREQUENCY AND CHARACTERISTICS IN THE UNITED STATES AS DETERMINED BY THE EXAMINATION OF RECRUITS. PIERCE BAILEY and ROY HABER, Ment. Hyg. **4**:564 (July) 1920.

Neuropsychiatric examiners of the Medical Corps identified 72,323 cases of nervous and mental disorders, and of this number 22,741, or 31.4 per cent., were mental defectives. Only those who are familiar with mental deficiency in all its phases will be able to estimate the tremendous economic asset and gain in morale to the A. E. F. which is represented by these statistics. It is interesting to note that in nineteen states the percentage of defectives was above the average for the entire United States, and that all but four of these states were southern. The negroes were listed separately, and in seven states the average was exceeded. Maryland showed 74.4 per cent. Of the whole group 71.8 per cent. were native whites and 18.7 per cent. native negroes, and the remaining 9.5 per cent. were foreign born. Of this last subdivision, 32.5 per cent. were Italians and 32.1 per cent. Russians. Great Britain and Switzerland were the only two countries that had under 10 per cent. of mental defectives.

The neuropsychiatrist, the psychologist and the sociologist will all be repaid by a careful study of this authorized report from the Surgeon-General's Office.

STRECKER, Philadelphia.

SINUSITE FRONTAL AIGUE ET PTOSIS (ACUTE FRONTAL SINUSITIS AND PTOSIS). G. LIEBAULT, Bull. méd. **34**:815 (Sept. 11) 1920.

In three instances recently the writer has seen acute unilateral frontal sinusitis associated with ptosis. Usually ptosis which develops during a sinusitis is due to the existence of infection of the perisinus tissue, with edema of the lid and other conditions. The writer has deemed his cases worthy of special report as in them the ptosis had no such basis; rather the lid was entirely free from edema. Its loss of normal movement was neural and was occasioned by a certain temporary involvement of the nerve fibers which pass along the floor of the sinus and enervate the levator. The author shows that there was no cellular infiltration, no conjunctival irritation or chemosis, no exophthalmos and no disturbance of the movements of the eyeball. Unfortunately, in two of the cases the fundi were not examined. In one case he reports an obscurity of the disk on the affected side. The infection of the sinus was purulent and outspoken.

The ptosis endured about ten days and disappeared as the sinusitis was relieved. This, in turn, was accomplished by medical measures, and surgical procedures were not followed in any instance.

DAVIS, New York.

COMPARATIVE STUDIES ON THE GROWTH OF THE CORPUS CALLOSUM. NOBUHARU SUITSU, J. Comp. Neurol. **32**:35 (Aug. 15) 1920.

In this first paper of a series the area of the corpus callosum as measured in sagittal section was studied in the albino rat at successive ages. Myelinated fibers are not present at birth; they appear at the seventh to tenth day. The area of the section increases between birth and maturity about three and a half times. This increase occurs in three phases which correlate with the functional development of the rat. During the first ten days of life new unmyelinated fibers are added. From the tenth to the thirtieth day the formation of new myelin sheaths is the main factor. After the thirtieth day the fibers increase in diameter, the increase continuing as long as the brain increases in weight.

HERRICK, Chicago.

EXPERIENCES WITH LUMINAL IN EPILEPSY. JULIUS GRINKER, J. A. M. A. **75**:508 (Aug. 28) 1920.

Grinker comments favorably on luminal as a convulsion controlling agent in essential epilepsy. In a series of 100 cases the seizures practically ceased for periods of time varying from several months to four years. The average dose was 1.5 grains, but if necessary double and even triple this amount was given. There seem to be no untoward effects beyond the occasional appearance of a slight rash. Apparently the drug does not produce mental sluggishness nor is it habit forming. In general, the author's results bear out the experience of Dercum and other observers.

The reviewer takes this opportunity of citing his own experience. Luminal has been extensively employed in the clinic for mental and nervous diseases of the Pennsylvania Hospital. It is effective not only in idiopathic epilepsy, but also in cases in which syphilis or other factors may be demonstrated. However, the distinction between so-called "essential" and other forms of epilepsy must

often be largely theoretical and the exhibition of luminal should not negative the effort to search for and correct possible causative factors. There is some reason to believe that this drug may have a direct influence on motor centers. In three cases of chorea the movements were promptly inhibited in two by luminal medication.

STRECKER, Philadelphia.

THE HEMORRHAGIC TENDENCY AS A FREQUENT CAUSE OF CRANIAL HEMORRHAGE OF THE NEW-BORN. JOHN A. FOOTE, Am. J. Dis. Child. **20**:1 (July) 1920.

In this article the author has followed the line of reasoning which he expressed in June, 1918, that many of the cases which do not show rupture of the meningeal artery are not frank hemorrhages so much as oozing of the vessels of the pia, and that great relief can be obtained by lowering intracranial pressure through lumbar puncture with some method to increase the coagulability of the blood, such as blood serum, citrated blood, etc. Within the last fifteen months, this procedure was followed at the Providence Hospital in Washington, D. C., in seven cases. In all new-born infants, showing, within from twelve to twenty-four hours after birth, respiratory distress and blueness with or without muscular rigidity and twitching, lumbar puncture was performed, and in every instance with these symptoms the lumbar puncture showed blood varying from a slight tinging to clots. Horse serum and thromboplastin were used hypodermically. One infant died; the other six have been traced and are still living. To corroborate his findings, the author quotes the clinical observations of Dr. Margaret Warwick who in thirty-six necropsies on still-born infants or on those who had died within a short period after birth found that 50 per cent. had hemorrhages in the dura, brain surface or ventricles; only one was a case in which forceps had been used. Two out of eighteen were born dead. In eight, or 50 per cent., of those showing cranial hemorrhage, hemorrhage was found in other organs. He quotes a case of a baby delivered with forceps after a long labor who two hours after birth became blue, and whose respirations were labored; coagulation time exceeded nine minutes; lumbar puncture revealed small clots. The child also vomited red blood, and blood came from the rectum, nose, stomach and ear. It was given horse serum and thromboplastin and recovered. The author finds, following Cushing and Sharpe, that simple surgical relief of pressure when a focal diagnosis can be made yields brilliant results and avoids the horrible paralysis known as Little's disease. An attempt to increase the coagulation time should be made prior to operation.

The author does not lose sight of the fact that hemorrhage may occur in the infant's skull, and without treatment may be followed by complete recovery. He makes a plea that routine coagulation time tests be made on the new-born infant.

WINKELMAN, Philadelphia.

EFFICIENT TREATMENT OF EPILEPSY BY LUMINAL. GASTON MAILLARD, Encéphale **25**:455, 1920.

Maillard, following the publication of Raffegean (*Société médico-psychologique*, Dec. 29, 1919), used luminal in all the epileptics on his service. He recalls that barbital (veronal, diethylmalonylurea) only differs from luminal (phenylethylmalonylurea) by a phenyl group. Since barbital has no effect

on epilepsy and luminal has, it would seem that the phenyl group is the determining factor.

Pecheux first noted the good effect of luminal in epilepsy in 1913, but it was not tried so much as an anti-epileptic as a depressant for certain excited phases of the disease. Frankenhauser noted good results in 1915. Maillard cautions that at first the dosage must be carefully watched. He starts with morning and evening doses of 10, 15 or 20 cg. (⅙, ¼ or ⅓ grain). Later the dose may be diminished to 5 cg. The most prominent symptom at the beginning is sleepiness. The patient awakens with difficulty in the morning and tends to fall asleep during the day. In a few cases there is a period of euphoria. These initial symptoms soon disappear. If, for some reason, the treatment is to be stopped, it must be done slowly, else there may be a sudden increase of severe attacks. Patients with psychic symptoms may show an exaggeration of these when the convulsion begins, diminishes or ceases, which Maillard interprets as a transference of the epileptiform explosion. Chronic psychopathic conditions, on the other hand, are improved by luminal.

Maillard used the drug for months without any ill effects, thus stopping the seizures and bettering the general psychic condition. He does not say whether the cure is permanent but promises another communication on this point after a longer experience with the drug.

In the discussion, Dr. Laignel-Lavastine mentioned a patient under luminal treatment for four years, in whom the motor seizures had ceased but who had severe spells of anger. Dr. Hartenberg mentioned two cases treated by luminal for from six to seven years with similar attacks.

KRAUS, New York.

THE CONDITIONS IN THE BRAIN DURING STAMMERING. EDITORIAL, J. A. M. A. **75**:608 (Aug. 28) 1920.

The theory of Bluemel that "stammering is caused by transient auditory amnesia in the auditory or speech center brought on by cerebral congestions" has been definitely established as a fact by the experimental work of Robbins.[1] The subject was a person who had sustained a bullet wound of the right frontal lobe without injury to the cerebral tissue. By means of a glass plethysmograph applied at the site of a small trephine opening, the increase in brain volume accompanied by an increase in the size of the pulse which occurred under conditions of pronounced shock, fear of stammering and other emotions, were noted and recorded. During intervals of normal reading the brain of the stammerer receded to its normal volume. "Evidently the fear of stammering and the forcing out of hard words which accompanies stammering causes vasoconstriction in the periphery and cerebral congestion. As Robbins expresses the situation, the congestion blurs verbal imagery, especially auditory verbal imagery, and makes it impossible for the stammerer for the time being to recall a part or the whole of the word he wishes to speak at the moment he has to say it." It is evident that in order to cure stammering both the fear and the accompanying abnormal muscular contractions must be overcome.

STRECKER, Philadelphia.

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1. Robbins, S. D.: A Plethysmographic Study of Shock and Stammering, Am.J.Physiol. **48**:285 (April) 1919.

ON THE ORIGIN OF THE GANGLION CELLS OF THE NERVUS TERMINALIS OF THE ALBINO RAT. F. W. STEWART, J. Comp. Neurol. **32**:99 (Aug. 15) 1920.

The recent demonstration of the presence of a distinct terminal nerve in close association with the olfactory nerve in all vertebrates from fishes to man continues to stimulate investigation regarding its connections and probable functions. In view of recent evidence tending to relate this nerve with the sympathetic system, the author has studied the development of its ganglion cells, confirming the conclusions of Brookover concerning fishes and the less definite results of earlier students in mammals that the ganglion cells of this nerve are derived by proliferation inward from the embryonic olfactory epithelium. None of these ganglion cells seem to arise from any of the sources usually recognized as giving rise to sympathetic neurons.

HERRICK, Chicago.

THE SIGN OF THE SUPRACLAVICULAR FOSSA (PARALYSIS OF THE SERRATUS MAGNUS FOLLOWING INFLUENZA). GEORGE GUILLAIN and E. VIBERT, Ann. de méd. **7**:383, 1920.

These authors present a case of isolated paralysis of the serratus magnus muscle following influenza, in which, besides the familiar signs of this condition, there existed a definite difference between the supraclavicular fossa on the well and affected sides. The sign appears on elevating or shrugging the shoulders. The fossa on the affected side was much narrower, measuring laterally from the midline. The clavicle appeared to be pulled upward and toward the middle of the back. The depth of the fossa on the affected side was diminished, due to filling up by the sternocleidomastoid muscle. Instead of a triangular space bounded by this muscle, the trapezius and the clavicle, only a narrow gutter-like space existed. This sign is of diagnostic interest and adds to our knowledge of a comparatively rare condition.

KRAUS, New York.

THE MOTOR NUCLEI OF THE CEREBRAL NERVES IN PHYLOGENY—A STUDY OF THE PHENOMENA OF NEUROBIOTAXIS. III. REPTILIA. DAVIDSON BLACK, J. Comp. Neurol. **32**:61 (Aug. 15) 1920.

This is one of a series of studies on the comparative anatomy of the motor nuclei of the cranial nerves from the point of view of the functional factors correlated with phylogenetic changes in their arrangement. In reptiles, as compared with still lower forms, the factors chiefly significant in this connection are the perfection of the apparatus for air breathing, the development of a mobile fleshy tongue, increased complexity of the jaw muscles and greater refinement of the sense of sight. There is considerable variation in the arrangement of these nuclei among the different groups of reptiles, and these differences are also correlated with diversity in modes of life.

HERRICK, Chicago.

ENDOCRINE IMBALANCE IN THE FEEBLEMINDED. Oscar Raeder, J. A. M. A. **75**:527 (Aug. 21) 1920.

The author has attacked this problem from the angle that is least open to criticism. He studied 100 cases of feeblemindedness from the standpoint of the necropsy findings. The results throw a new light on endocrine pathology in mental deficiency. In ten instances, "extreme," in eleven, "marked" and in fifty-three "moderate" glandular changes, including aplasia, hyperplasia, pigmentation and interstitial changes, glandular proliferation and various quantitative anomalies, were revealed both by gross examination and under the microscope. The pituitary gland was involved most frequently and was closely followed by the sex glands. The only weak point of Raeder's contribution is the absence of serologic investigation in many of the cases and the consequent failure to exclude completely a possible syphilitic factor.

The value of this type of work cannot be over-emphasized. It should not only stimulate similar investigations, but should also furnish an incentive for intensive clinical and experimental therapeutic research.

Strecker, Philadelphia.

SUR L'ENCEPHALITE LETHARGIQUE (LETHARGIC ENCEPHALITIS). Léon Bernard and Jules Renault, Informateur d. alién. **15**: 174 (June) 1920.

Bernard and Renault presented to the Paris Academy of Medicine, May 18, the results of a national survey of lethargic encephalitis. In the fifty-five departments reporting, there had been 70 cases in January, 206 in February, 144 in March and 44 in April—465 in all. Children seem to have been affected half as often as adults, and persons over 60 were affected very rarely. The mortality had been 10 per cent. Cases had invariably been rather widely scattered, no direct contagion being observed. The disease has generally been thought to be spread by carriers. All reports were unfavorable to the idea of a relationship between poliomyelitis and lethargic encephalitis, but the probability of some connection between encephalitis and grip has often been noted.

Huddleson, New York.

INFLUENCE OF WAR ON CONCEPTS OF MENTAL DISEASES AND NEUROSES. Sidney J. Schwab, Ment. Hyg. **4**:654 (July) 1920.

Schwab attempts to evaluate the material gains to neuropsychiatry which have resulted from the wholesale war experiment of bringing the complex and highly developed human nervous system into contact with destructive forces and conditions. He points out that we have every reason to expect additions to our knowledge of the physiology of the peripheral nerves and the central nervous system. In the field of psychoneuroses the net gain should be a better understanding of mechanisms and a consequent stimulation of logical methods of therapy. The relative curability of episodic "war psychoses" should encourage the psychiatrist in dealing with the psychoses of civil life. The final, and perhaps most important, fact is that awakened and stimulated professional and public interest practically guarantees an earnest effort to apply our war won knowledge to all neuropsychiatric problems of civil life.

Strecker, Philadelphia.

Society Transactions

NEW YORK NEUROLOGICAL SOCIETY

The Three Hundred and Eighty-Second Regular Meeting, Oct. 5, 1920

WALTER TIMME, M.D., *President*

A CASE OF LETHARGIC ENCEPHALITIS. Presented by DR. ISADORE ABRAHAMSON.

An unusual case of lethargic encephalitis was presented for the purpose of showing how intensive study of this disease had shed light on many obscure points in the pathology of diseases of the nervous system. New names are frequently attached to unusual variations of one disease, and discoveries of distinct disease entities are heralded without cause. The patient illustrating the complexity of encephalitis manifestations was an Italian butcher. His previous personal history was negative. The initial symptoms were pain in the mastoid, left occiput and left shoulder. There was fever for three days, followed by a lethargic sleep for two weeks, from which he was easily aroused, answering in a typical fashion. Movements set in, being first present in the left shoulder and afterward in the left index finger. The other hand was soon affected and the speech became markedly involved, being dysarthric, not aphasic. There was no fine tremor. The legs were involved later. Pains and paresthesia in the suprascapular region and nape of the neck have persisted from the time of the onset nine months ago until the present. The patient complained of formication about the left shoulder. Neurologic examination showed the right pupil ovoid up and down and sluggish to light; accommodation was normal. The left pupil was ovoid from side to side; accommodation was not so good; it was sluggish to light.

The most marked feature exhibited by this patient was the nature of the movements of the upper extremities, the left especially. The movements were slower than those of chorea and resembled intentional movements, being slow, coordinated and asymmetrical. There was no fibrillation or myoclonia. Every movement of a muscle is followed by movement of a part, both antagonistic and synergic. There is thus presented in this patient, as a late sign of an undoubted lethargic encephalitis, a disturbance of motility, without ataxia, without loss of power, atrophy or dysmetria, showing no dyssynergia or myoclonia. There are evidences of sensory irritation still persisting. The movements are neither choreic nor paramyoclonic, nor do they resemble those of dyssynergia cerebellaris. They are not hysterical. They are not the movements of dystonia. There is no torsion spasm of the pelvis or neck. They are extrapyramidal, not induced by pain or paresthesia. It is impossible to designate the affliction by any accurate form in the recognized categories. The accepted classification of disease according to manifestations is here clearly seen to be untenable.

A CASE OF LETHARGIC ENCEPHALITIS. Presented by Dr. Thomas K. Davis.

The patient was a young woman in whom encephalitis had been a complication of pregnancy. The encephalitis began three weeks before the birth of a child in February, 1920, and quite early took the pseudoparkinsonian form. With this, the arms assumed a constant tonic contracture across the chest, each elbow being strongly flexed. They could be passively extended only with great difficulty. The physician who saw her at that time placed the arms in full extension in plaster casts, which were worn for three weeks. This resulted in the arms becoming rigid at full extension. It has been quite impossible to flex either elbow since.

There is usually a fine tremor of the hands. There have been no pyramidal tract signs.

A roentgenogram of the right arm showed a faint suggestion of new bone formation at the elbow, possibly beginning ankylosis. In the left arm, bony changes were absent and the high degree of muscular tone apparently alone produced the rigidity of this arm.

DISCUSSION

Dr. Foster Kennedy pointed out that this second case was practically the reverse of that shown by Dr. Abrahamson. There was apparently overtoning of the cervical muscles. The trunk muscles were not affected.

Dr. Isadore Abrahamson called to mind a patient with spondylos rhizomelique who exhibited the same pains, attitude and rigidities as the second patient, in whom the condition had been the result of immobilization. There were, however, no signs of cord or brain implication. Dr. Abrahamson regarded the case presented as both lethargic and spondylotic.

Dr. C. B. Craig had seen the first patient at the Neurological Institute for a period of two weeks in June. His condition had not changed from that time. It was observed that the motility ceased during sleep. Faradism had proved to be beneficial, its effects lasting from one to three hours. This was probably a fatigue phenomenon. The case was diagnosed as chorea following lethargic encephalitis.

Dr. Bernard Sachs remarked on the interest attached to two such diametrically opposed cases. He said he hoped to gain anatomic information from them and was especially interested to know what part of the brain was responsible for the disturbances of motility. The condition of the last patient resembled certain infantile hemiplegias that he had seen. In Dr. Abrahamson's case the movements were distinctly choreic, arrhythmical, more or less purposeful and of slightly explosive character. They were slower than ordinary chorea minor, and not so fast as electric chorea, yet they were distinctly choreic as opposed to myoclonic and myotonic. It would be interesting to know the part of the nervous system that was responsible. The movements were evidently the result of encephalitic processes and were certainly not hysterical. Dr. Sachs' belief was that it was a ganglionic disturbance near one of the larger ganglions and not a cortical disturbance.

Dr. Michael Osnato stated that he had had the first patient under observation since May, 1920, when he was shown to the students at Columbia as a case of encephalitis. He had noticed a rhythmicity of movement, the movements occurring four or five to the second. A considerable improvement had

undoubtedly occurred. Malarial parasites had been detected in the patient's blood and suitable treatment had been given.

Dr. Smith Ely Jelliffe said that the syndromes of postinfluenzal and postlethargic encephalitis were becoming more interesting, and they were turning up in greater abundance in private practice, as the increasing attention given to them, in the advancing masses of the literature, was making physicians more observant of the possibilities. These cases had been in existence for many years but heretofore had been distributed into larger and looser nosologic conceptions; and their etiologic relationships to the infections, especially to that of influenza, were largely overlooked.

In the cases under consideration, particularly the case of Dr. Davis, emphasis had been laid on the segmental distribution of the tonic fixation. It involved an entire limb. One point of possible localization had been omitted thus far in the discussion to which Dr. Jelliffe thought attention might be directed. This was the possibility of cerebellar pathway disturbance in certain types of cases, of which Dr. Abrahamson's case might be an example. The studies of Bolk and Rynberk have cleared up much of our knowledge concerning the localization of function of limbs in the cerebellum, and some cases were on record in which segmental motor disturbances of a choreic or tic-like character, as seen in Dr. Abrahamson's case, could be referred back to foci of destruction in the cerebellar mechanisms. Thus Klein (*Monatschr. f. Psychiat. u. Neurol.*, 1918) reported an interesting choreic-like disturbance from a small cyst in the dentate nucleus. As the fatal cases are usually fulminating and rarely afford opportunity to clear up the complete pathology, it would probably take many years before the valuable localizing lessons could be gained from the study of these residuals of mesencephalic involvement.

Dr. Abrahamson, in summarizing the discussion on his patient, said that he doubted the correctness of the localization in the cerebellum, since the patient showed none of the symptoms of cerebellar disease. His case was distinctly one of disease of the communicating pathways and not of the centers.

A CASE OF PYRAMIDAL SCLEROSIS FOLLOWING ELECTRIC BURNS. Presented by Dr. Foster Kennedy.

The patient had been working in front of a dead cable when a charge of 1,100 volts was sent through it. He remembered nothing of the accident and was unconscious for eleven hours after it. The accident occurred six years ago, and he was paralyzed immediately thereafter. He now has spastic legs and double ankle clonus. He has control of the bladder, but incomplete control of the rectum. A large scar is visible on the left scapula, showing the point of ingress of the charge, and a smaller one is found on the left buttock at the point of exit. There were no neurologic signs of interest except the spastic paraplegia. The burn was a third degree burn. Within two years of the injury the patient began to have a double cataract. The lens in the right eye has been removed. Dr. Kennedy said that his information in regard to nervous system results of this type of injury was slight, and asked for any points of interest from the audience.

Dr. Smith Ely Jelliffe said that by chance he had just finished a revision of the chapter on electric injuries in Peterson and Haynes' "Legal Medicine" and had thus had occasion to review the extensive literature. Results of electric injuries of this type producing myelitis from lumbar foci, were

extremely rare, but were well known. A review of the entire literature has been given by Jellinek quite recently.

Dr. Isadore Abrahamson asked whether the pathology of this case would resemble cases of caisson disease.

Dr. Smith Ely Jelliffe pointed out that the force of the current acted as a disruptive agent, whereas the gas in caisson disease had an eruptive effect.

Dr. Michael Osnato was interested to know why the current had selected the pyramidal tracts and had missed the others. It appeared strange that the other tracts and cells and columns of the cord had so completely recovered.

Dr. Smith Ely Jelliffe said that the current was not selective but that now six years after the accident much of the condition had cleared up. Disturbances of vegetative function had existed, however, and were still in evidence, notably the cataract.

CLINICAL SYPHILIS OF THE CENTRAL NERVOUS SYSTEM. Presented by Dr. Junius W. Stephenson.

In a plea for the more fundamental instruction of medical students in the practical aspects of syphilology, a brief classification along lines suitable for complete and rapid instruction was given. In attacking the nervous system, Dr. Stephenson pointed out, syphilis rarely attacks en masse, but produces symptoms referable to a patch of meninges here or there, a blood vessel of small caliber, or a tract in the spinal cord. The accuracy of diagnosis largely depends on the individual's knowledge of the anatomy and physiology of the nervous system. The successful treatment of syphilis accordingly depends on proper discrimination as to what anatomicophysiologic destruction is caused by the initial invasion, the condition of certain structures being unalterable, while others would be amenable to treatment. Thus the importance of the early recognition of syphilis is to be emphasized. When the average patient reaches the neurologist, the damage is, usually, too extensive for much improvement. The ability to recognize the disease in the early stages is therefore of the utmost importance.

The one criterion of syphilis is the Argyll Robertson pupil, but this is not a preliminary sign. Any irregularity of the pupil in patients below the age of 40 years should be considered syphilitic until proved otherwise. A further sign of diagnostic value is one that Dr. Stephenson has styled the "dead man's pupil." Experience is necessary to recognize this sign.

The symptoms of syphilis within the cranium, those of meningitis, isolated gumma, cerebral vascular syphilis, thrombosis of the posterior inferior cerebellar artery, general paresis (meningeal and parenchymatous) and syphilis of the optic nerve, were briefly outlined, following which Dr. Stephenson surveyed the type of syphilis involving the spinal cord, touching on the principle diagnostic points and certain special tests and signs that he has found of value. The entire field of syphilitic disease was rapidly summarized and the earmarks of the various types set forth for rapid and easy assimilation.

Dr. Foster Kennedy, in discussing Dr. Stephenson's paper, spoke of the curious refractive phenomenon which caused what Dr. Stephenson had designated as the "dead man's pupil." Although, as he had said, it required skill in learning to recognize it, yet Dr. Kennedy felt that it had a diagnostic value.

STUTTERING: ETIOLOGY AND THERAPY. Presented by Miss Hannah M. Creasy, by invitation.

Miss Creasy stated that it was her impression that speech specialists should endeavor to gain the cooperation of neurologists if the profession of speech correction were to assume the dignity and gain the respect that it deserved. In her work she had found that there was no royal road to recovery. Her object in presenting her methods was to show the philosophy underlying them.

Stuttering, including stammering, she defined as the inability to speak at will. It is a mental condition, a psychic neurosis, not physical, and frees itself in somatic symptoms, such as cramps and excessive tension of the organs of speech. There is lack of harmonious working between the brain and the speech organs. The speech mechanism is not at fault. It is the mind that is tied, not the tongue. Stuttering must accordingly be traced further back than the symptoms, or even the trauma producing the symptoms.

Every experience which produces a painful effect of fear, anxiety, shame, etc., may act as a psychic trauma, and may produce pathologic results, if it falls on fertile soil. "In order to create nervousness," says Charcot, "two factors are necessary—one permanent (the neuropathic predisposition), the other contingent (the provoking agent)." A shock may have brought out the symptoms, revealing the permanent neurotic background. After the effects of the shock may have been removed and the symptoms cured, another shock may again reveal the constitutional weakness and the cure be undone. This has occurred in many of the so-called shell shock cases in the war.

The dominant quality in the syndrome of stuttering is fear—fear of people, or of speaking before people. On entering school, the stutterer carries his fear over from his home environment to any one in authority, any one he thinks might be hostile and unsympathetic. In the best of environments intelligent sympathy may be lacking. The fear attached to stuttering is a morbid fear. It does not arise from the shock, it arises from an internal condition. The history of frights, shocks, accidents and other attributed causes of stuttering show that they might have resulted in a temporary normal fear. The patient's make-up has predetermined the morbidity of the fear. According to Frink, the manifestation of an anxiety hysteria is a morbid fear and the physical accompaniment thereof. Stuttering may be considered a manifestation of anxiety hysteria.

Accepting the premise that stuttering is a fear neurosis (anxiety hysteria), Miss Creasy's treatment follows along the lines laid down for other psychoneuroses. The work is largely a matter of character building—reorganization of the emotional life. To counteract the attributes of fear, cowardice, and stubbornness, environmental trends are recognized to bring about a more normal reaction to life, to produce fearlessness, self control and moral courage. An example of this method given was that of a student who, when asked why he stuttered more than usual at one time, replied that he had been worsted in a fight. His tendency to expect defeat was pointed out to him and he was told to approach his next fight with his mind made up to win, and to stay at the job until he did so.

The personal equation of the doctor in this branch of therapy, as in all others, is of great importance. The understanding of the patient, and letting him know that the doctor understands his peculiar difficulties, will go far toward

altering his attitude toward others. Thus, with the friendly cooperation of teachers and schoolmates, Miss Creasy has found that fear will gradually give way.

The stutterer's bodily health and environment should have careful attention. Segregation of stutterers is not desirable. The symptoms may be removed under institutional care, but the problems in the unfamiliar outside world will cause them to return again. Children should be kept in school and in touch with normal life in every possible way.

To attain fearlessness the patient is given a new method of speech. The sufferer is unable to get over the initial consonant sound to the vowel. The psychic fear causes an overinnervation in the occlusive, consonant sounds, and an inability to coordinate the consonant with the vowel in the syllable. The patient is shown that normal speech differs from his in the weaker consonant obstruction. The work proceeds with the syllable, coordinating the consonants and the vowels. Vowel valuation is made the keynote of the work. The patient is trained to consider the vowels as life savers. The mental attitude of fearlessness and self confidence inculcated by the care of the treatment, together with the scientific aids to phonation, when made clear and reasonable to the stutterer, enabled the work to proceed surely and with lasting success.

DISCUSSION

Dr. A. A. Brill agreed that the genesis of the stuttering was in the situation of the patient. Many cases of stuttering starting after puberty were easy to cure, since the stuttering was a symptom of a neurotic condition. Too much time, he felt, should not be devoted to routine practice. Most of the sufferers should be treated as average psychoneurotics. The prognosis in stuttering is usually bad. The treatment is lengthy and trying. The permanency of the cure cannot be guaranteed.

Dr. Neustaedter congratulated Miss Creasy on her conservatism and perseverance. He remarked that stammerers do not stammer when they sing. If the patient can be kept talking slowly the stammering can be largely overcome.

Dr. Smith Ely Jelliffe agreed with Miss Creasy's final summary of the extreme complexity of the situation. He did not believe that even the majority of cases could be ranged in the anxiety hysteria group. The reasons for the types of results obtained lie in the nature of the beginning of the neurosis. The compulsive type, beginning in the auto-erotic period is treated with extreme difficulty, especially when the muscle erotic is involved. Such patients are prone to relapse and require much time. Miss Creasy's effort in establishing a transference is sane and advisable. The most promising part of her presentation, Dr. Jelliffe felt, was the beginning of cooperation between the layman and neurologist. There are not enough neurologically trained physicians to handle psychoneurotic problems in the community. If intelligent cooperation can be established between the neurologist and the sincere helper, much help can be obtained.

Miss Hannah Creasy, in closing, said that since the work in public schools had been developed, rapid advance had been made. Cooperation and team work made the advance more successful. The work in the schools was more favorable than in private work, since in the home there is backsliding. Until the parents will cooperate, therefore, training in schools is advisable. Team work is most necessary to combat the time required and the difficulty of the cure.

Book Reviews

STUDIES IN NEUROLOGY. By HENRY HEAD, M.D., F.R.S., in Conjunction with W. H. R. RIVERS, M.D., F.R.S., GORDON HOLMES, M.D., G.M.G., JAMES SHERREN, F.R.C.S., THEODORE THOMPSON, M.D., and GEORGE RIDDOCH, M.D. Two volumes. Cloth. Price $17. Pp. 862, with 182 illustrations. New York: Oxford University Press, 1920.

These volumes consist mainly of a number of papers published by Head and his co-workers in *Brain*, over a period of time extending from 1905 to 1918. No material change has been made in their arrangement. Each paper detailed the methods of testing sensation. These pages have been eliminated, and a separate chapter in which they are combined has been added, as have also an introduction and an epilogue dealing with the common aims that underlie the various researches. Finally, in an appendix, some of the most serious criticisms of their work have been seriously considered.

The first volume consists of two parts: the first devoted to an introduction and methods of examination; the second to the peripheral nervous system. The second part consists of three papers: "The Afferent Nervous System from a New Aspect," "The Consequences of Injury to the Peripheral Nerves," and "A Human Experiment in Nerve Division." The profound studies described in these three papers resulted in a new conception of the physiology of sensation, which has been widely accepted. The results of their brilliant studies led Head, Rivers and Sherren to conclude that the sensory mechanism in the peripheral nerves consists of three systems: deep sensibility, protopathic sensibility and epicritic sensibility. Whereas previous observers had stated that sensation is diminished over the full area usually assigned to the injured nerve and lost completely over a small portion only, they have shown that this diminution of sensation is, in reality, a total loss of sensibility to stimulation with absorbent cotton, to the compass test, to the painless interrupted current, and to degrees of temperatures between 22 C. and 40 C. In this area are felt only the stimuli affecting protopathic sensibility, such as the prick of a pin and temperatures below 20 C. and above 40 C.

In the chapter on injury to the peripheral nerves are found some illuminating observations on changes in the skin and nails and comments on paralysis, emphasizing the effect of supplementary motility.

The second volume is devoted to studies of "The Grouping of Afferent Impulses," "Sensory Disturbances from Cerebral Lesions," "Sensation and the Cerebral Cortex," and the automatic bladder, excessive sweating and some other reflex conditions in "Gross Injuries of the Spinal Cord."

The chapter on the grouping of afferent impulses is concerned with observations showing that "as soon as a sensory impulse reaches the first junction in the spinal cord it becomes shunted into tracts devoted to the conduction of impulses, grouped in a way different from that found in the peripheral nerves." It is no longer a question of protopathic, epicritic and deep sensibility; each tract in the central nervous system is devoted to the conduction of one of the specific impulses, such as pain, touch, heat and cold. After showing that afferent impulses that reach the central nervous system by way of the peripheral nerves undergo rearrangement within the spinal cord, the authors attempt to trace their course upward, indicating the relation of each

set of impulses to the other. Painful, thermal and tactile impulses ultimately pass from the point of entry to the opposite side of the spinal cord, but before they pass across they have undergone the characteristic recombination that occurs in the same half of the spinal cord by which the impulses enter.

The observations noted in injuries of the spinal cord permit important conclusions relating to diagnosis, prognosis and treatment in such cases.

Continuing their researches to the brain, there are exhaustive studies on grouping of afferent impulses in the brain stem, sensory disturbances from lesions of the optic thalami and the cerebral cortex, and a completion of their conception of the physiology of sensation with a study of the cerebral cortex and sensation.

The observations made during the late war have reawakened an interest in the problems of sensation, particularly in reference to the peripheral nervous system. It may be predicted that as wide an interest will develop relative to the spinal cord, the cerebral cortex and the brain stem. We owe considerable gratitude to Head and his co-workers for assembling their illuminating studies so that one may view in a comprehensive manner their conception of the physiology of sensation.

The case reports are so full and the illustrations so profuse that the volumes will interest not only neurologists, but also other clinicians and physiologists.

EPIDEMIC ENCEPHALITIS (ENCEPHALITIS LETHARGICA). By FREDERICK TILNEY, M.D., PH.D., Professor of Neurology, Columbia University, and HUBERT S. HOWE, A.M., M.D., Instructor in Neurology, Columbia University. Cloth. Price, $3.50. Pp. 252, with 58 illustrations. New York: Paul B. Hoeber, 1920.

Most of the original material forming the basis of this book, including the illustrations, has appeared in two articles in the *Neurological Bulletin*, one by Tilney and Henry Alsop Riley, the other by Howe. In Part 1, based on the former article, twenty cases are related and subdivided into the following groups: (1) lethargic, (2) cataleptic, (3) paralysis agitans type, (4) polio-encephalitic, (5) anterior poliomyelitic, (6) posterior and (9) infantile (neonatorum). There are brief chapters on analysis of symptoms, prognosis and diagnosis, nature of the disease and treatment. In Part 2, based on Howe's cases, a different classification is used, namely: (1) cases with general symptoms indicating involvement of the nervous system, but absent, scant or fleeting localizing signs, (2) meningitic type, (3) cortical type, (4) pyramidal system type, (5) thalamic type, (6) corpus striatum (extrapyramidal type), (7) brain stem type, (8) cerebellar type, (9) spinal type, (10) peripheral nerve type and (11) multiple diffuse lesion type. This part includes also chapters on general subjects, partly including ground covered in Part 1, and numerous case reports. The two articles that form the gist of the book contain well studied and excellent material and the same is true of the book, but the now exceedingly voluminous literature is not adequately sifted, and on account of the rather disjointed construction of the book the reader will have to spend some time in finding the information wanted. However, many exceedingly useful and dependable data may be gathered from it.

We are grateful to the authors for their work, which just now fills a much needed want, but we hope that before long these authors or some one else will produce in monograph form a thorough and all-inclusive critical review of this timely subject.

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